THE AEROPLANE

FEBRUARY 10, 1961

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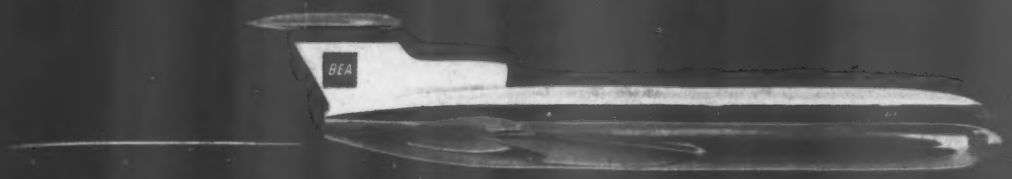
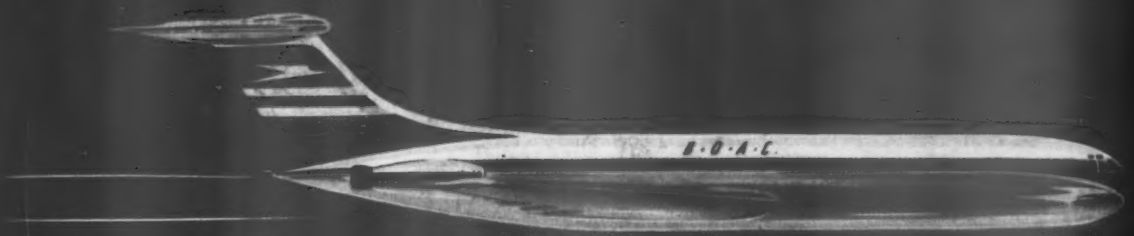
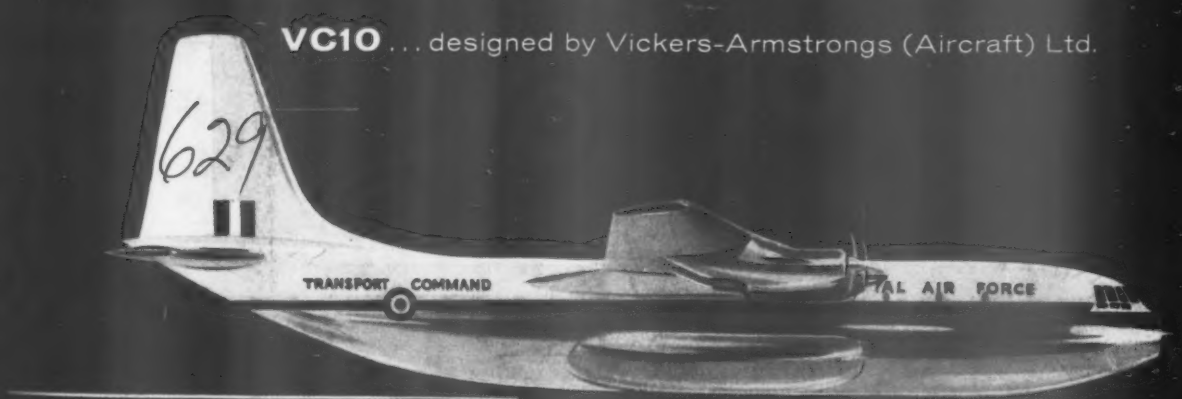


D.H.121-TRIDENT ... designed by de Havilland Aircraft Co. Ltd.



VC10 ... designed by Vickers-Armstrongs (Aircraft) Ltd.



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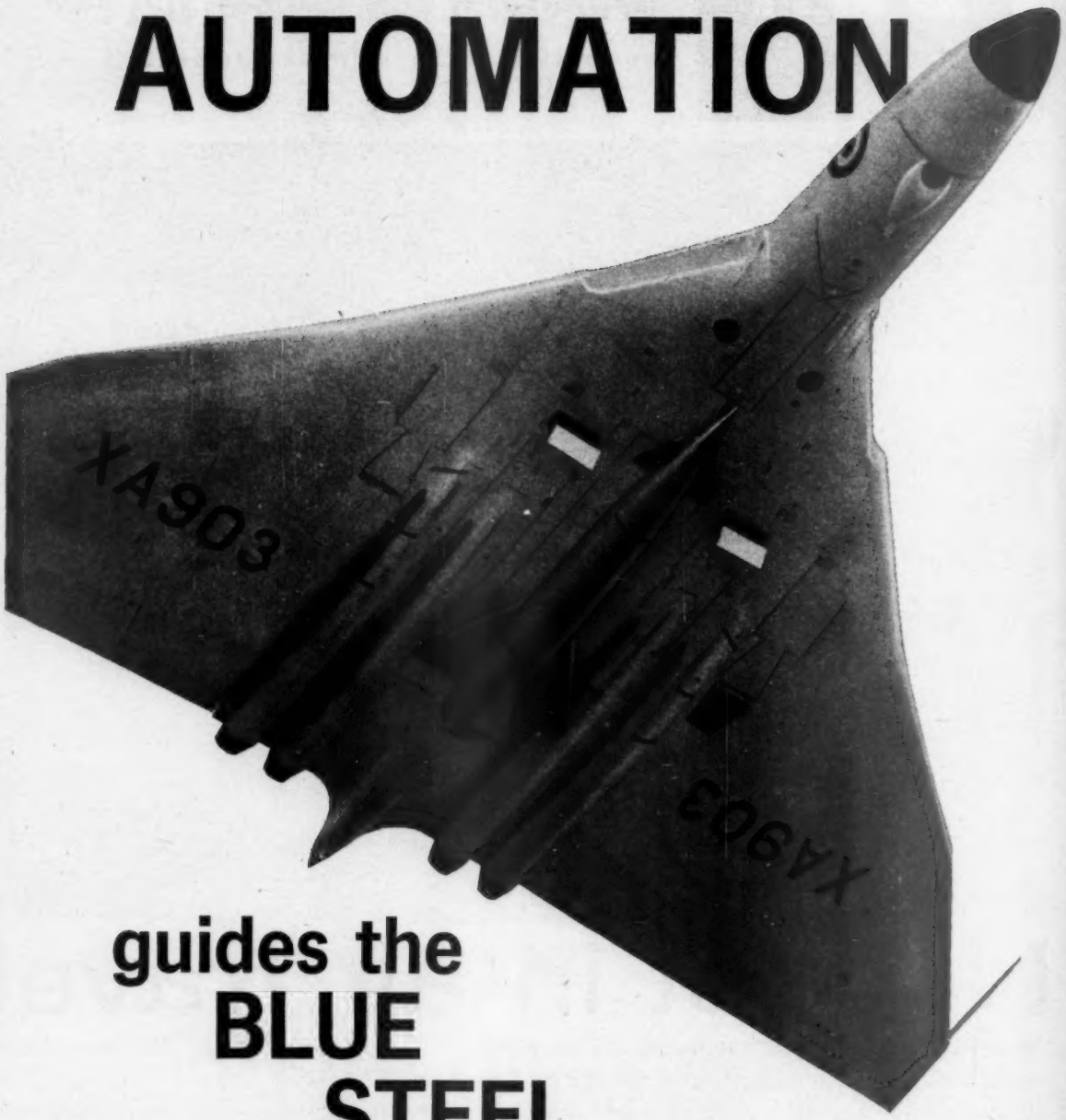

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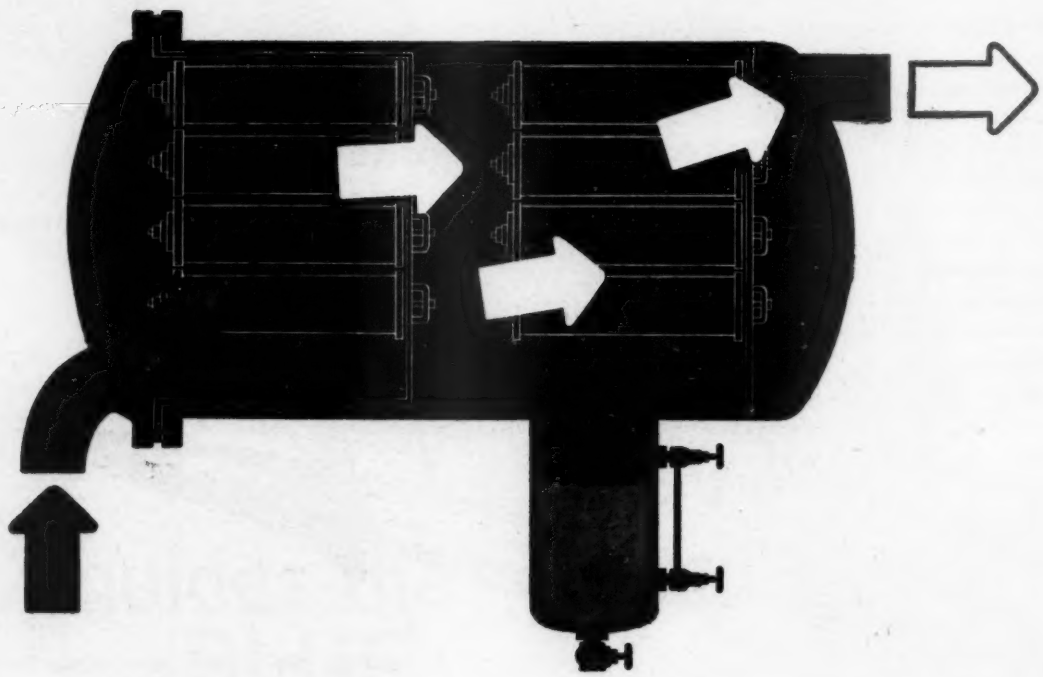

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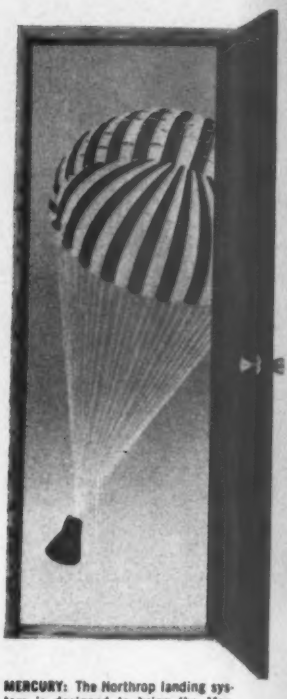
POLARIS: Northrop's Datico checks out Polaris at all levels of maintenance and operation.

SKYBOLT: Guidance and navigation systems are being developed by Northrop for this new and highly secret air-launched ballistic missile.



MERCURY: The Northrop landing system is designed to bring the Mercury astronaut down safely.

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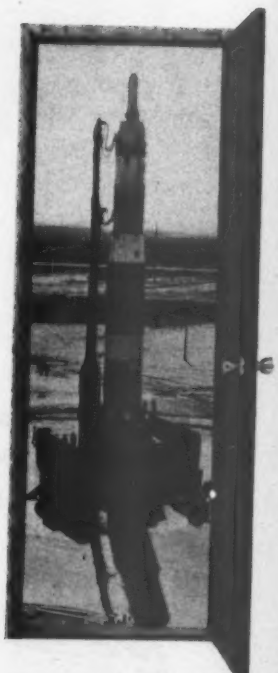
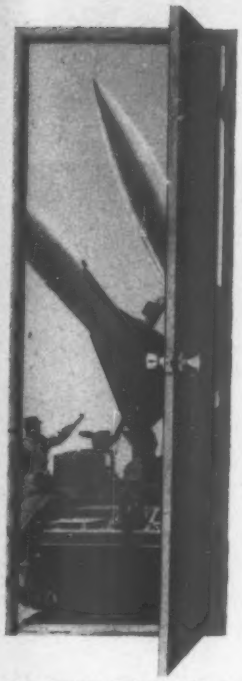
X-15: Northrop produces Q-Ball, the flight angle sensor for safe re-entry of X-15 and other aerospace vehicles.

AERODYNAMICS: Northrop's Laminar Flow Control technique is designed to greatly increase aircraft range, flexibility, cargo and passenger capacity.

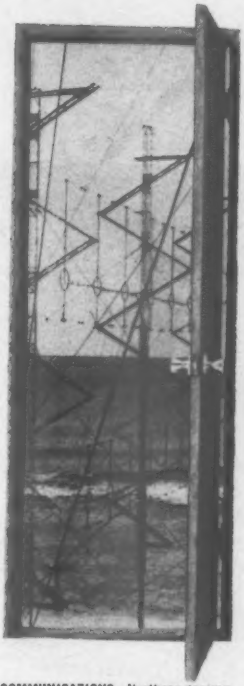


TITAN: Northrop supplies complete technical and industrial management to activate the T-2 Titan missile base.

Northrop Corporation, Beverly Hills, California • Divisions: Norair, Nortronics, Radioplane, Northrop International



HAWK: Northrop produces airframe components, ground handling and launching equipment for this air defense missile.



COMMUNICATIONS: Northrop designs the trans-Pacific Scatter Communications Network and other worldwide communication systems for U.S. and free world governments.

T-38: World's first supersonic twin-jet trainer is built by Northrop for the United States Air Force.

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THE AEROPLANE and ASTRONAUTICS

VOLUME 100 NUMBER 2573 FEBRUARY 10, 1961

Business Opportunities in Space

How quickly circumstances can change when men of vision get seized of an opportunity. For years now young men in this country have been seeing visions of what Great Britain ought to be doing out in space. Older men have had their dreams. But in the scientific world there were many who were not only unenthusiastic but frankly denigratory. Now has come the announcement, via that businessman of vision, Sir Robert Renwick, that the British Space Development Corporation has been formed by eight leading British companies. Study of its articles of association (p. 132) discloses that, to use a phrase that must now be regarded as obsolete, the sky is the limit to the potential activities of the new concern.

There will be many who will be specially delighted that the newly founded Corporation has specifically designated itself British. Surely, no one can doubt that a country's first responsibility is to thrive by its own efforts. Indeed, international groupings in these days may on occasion be regarded as attempts to take advantage of the other chap's efforts. Furthermore, the larger the international grouping the slower the pace, as the German reaction last week to the Strasbourg proposals has demonstrated.

There is a point of view, and there will be many who commend it, which argues that this question of European collaboration needs to be hurried along very slowly. A joint exercise must be seen to be jointly beneficial and each country must feel itself to be contributing not only in funds but also in technical know-how. This point has been emphasized at Strasbourg.

Perhaps we should begin with national feasibility studies. The British Space Development Corporation might care to undertake the one for the U.K.

Low-power Turbine in the Air

For many readers the most interesting story in this week's issue will be the report on flying behind the Rover 60 gas turbine. The full account, yet to be told, of how ways and means were found to get the Rover 60 installed as a powerplant will one day make fine reading. Meanwhile, as our report shows, the promise of this industrially proved unit is distinctly exciting.

The next step, that of producing the developed version of the unit to give 120 h.p. for take-off with no increase in installed weight, will be awaited with impatience. And that impatience will be whetted by reading of the actual experience of what it feels like to fly behind a turbine in a light aeroplane.

Kerosene—A Government Inquiry

Lord Brabazon's single-handed fight to ensure that airlines use the safest obtainable fuel has made more progress. Last week the advantages of kerosene versus JP.4 were debated in the Lords. By the end of the discussion the announcement had been made on behalf of the Government (p. 134) that the Minister of Aviation had instituted a technical inquiry. It was good to see that B.U.A. has confirmed that it will continue to use kerosene as opposed to JP.4.

Keep it up, Lord Brabazon!

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Matters of Moment

Business Moves Into Space

THAT Space is no longer to be regarded as a province for scientific experimentation but is to be taken as a lucrative field with limitless possibilities of business expansion has been emphasized by the news last week of the formation of the British Space Development Company by eight leading British businesses. Its first members, named on Feb. 2, are Associated Electrical Industries, Associated Television, British Insulated Callenders' Cables, Decca Radar, de Havilland, Pye, the Rank Organization, and Rolls-Royce. Work of some of these concerns in the satellite field was outlined in our article, "Industrial Participation in Space" (THE AEROPLANE AND ASTRONAUTICS, Jan. 27, 1961, p. 100).

The fact that astronautics, by its nature, must ultimately be seen as a World activity has led the founders to believe that not only will the company gain increasing support from British industry—Bristol Siddeley is reported to have already expressed an interest—but that certain prominent American organizations will also be involved. Possible moves in the general direction of co-operative research with communication satellites, involving NASA and such private concerns as the American Telephone and Telegraph Company, were discussed in our article, "Go-Ahead for Satellite Relays," last week.

With an initial capital of £20,000, the group's first object will be to act as an agency and liaison organization. But eventually it is hoped to support a large research and development programme, capable of exploiting the development of satellites of all kinds, including, of course, the communication satellite in which there are seen to be rich financial rewards.

One of the group's promoters, SIR ROBERT RENWICK, made these comments at a press conference in London on Feb. 2: "We who have formed this company believe the money in Space is more than any man ever dreamed of. It is colossal. We believe the gentlemen adventurers of Space have a much bigger chance of vast wealth than ever did the adventurers of the Hudson's Bay Company or the East India Company. It is the real Eldorado of the future. If we are not in Space, London ceases to be the centre of the World as far as communications are concerned."

The new company, Sir Robert continued, would be Britain's first industrial, free-enterprise, springboard into Space. There was no enterprise in the World which had yet been envisaged "where such a wide cross-section of industry has come together to pool its resources, know-how and effort in order to compete in this demanding, expensive, but ultimately most lucrative field with its limitless possibilities."

He gave the following as the company's principal objectives:—

(a) To provide an organization to discuss with the Government and co-operate in any proposals that the Government may make in regard to a U.K. and Commonwealth Space Programme, which is either independent of European participation or which includes European participation;

(b) To provide the Government with an indication of the faith that British industry has in the exploitation of Space and to show its readiness to play its part and to take its share of the risks as well as its share of the future benefits;

(c) To offer the Government an industrial body broadly based to act as an authority or agency to conduct research and development and to implement and operate a Space programme and to consider and develop all the possible areas of exploitation of Space;

(d) To provide those industries concerned with an organization to negotiate with other countries or foreign industrial organizations or consortia any matters concerning the commercial uses of Space which are likely to have global implications, i.e. communications, broadcasting, television, meteorological forecasting and navigational aids;

(e) To provide the greatest economy in the use of the limited number of technical personnel available in this country, particularly in the field of astro-physics and astronautical engineering and to ensure that duplication of effort, which has been so prevalent in the U.S.A., and which has contributed to wasteful use of resources, is avoided in the U.K.;

(f) To encourage the provision of and to provide directly, in due course, facilities for the training of technical personnel in all those sciences associated with Space research and the exploitation of Space; and

(g) To preserve for British industry a place in Space and a proper share of the national and international benefits deriving from the development and use of Space.

The articles of association define the new company's interests as being particularly applicable to the following:—

(1) Aviation, aeronautics, aerodynamics, ballistics, astronautics, meteorology, astronomy, electricity, electronics, nuclear and non-nuclear chemistry and physics, and metallurgy;

(2) The exploration and investigation reporting and recording of the characteristics of outer Space and of astral, lunar and satellite bodies within or without the Solar System; and the reporting and recording of the results of such explorations and investigations;

(3) The propulsion and direction of vehicles, missiles and artificial satellites within the atmosphere and stratosphere and outer Space, and the reporting of the movements of vehicles, missiles and satellites;

(4) The employment of vehicles, missiles and artificial satellites in relation to telecommunications, television, meteorological reporting and other useful purposes;

(5) Any other science or application of science which may be thought to be allied with or ancillary to, or capable of being advantageously combined with, the foregoing or any of the other objects of the company.

Full-scale Jet-flap Research

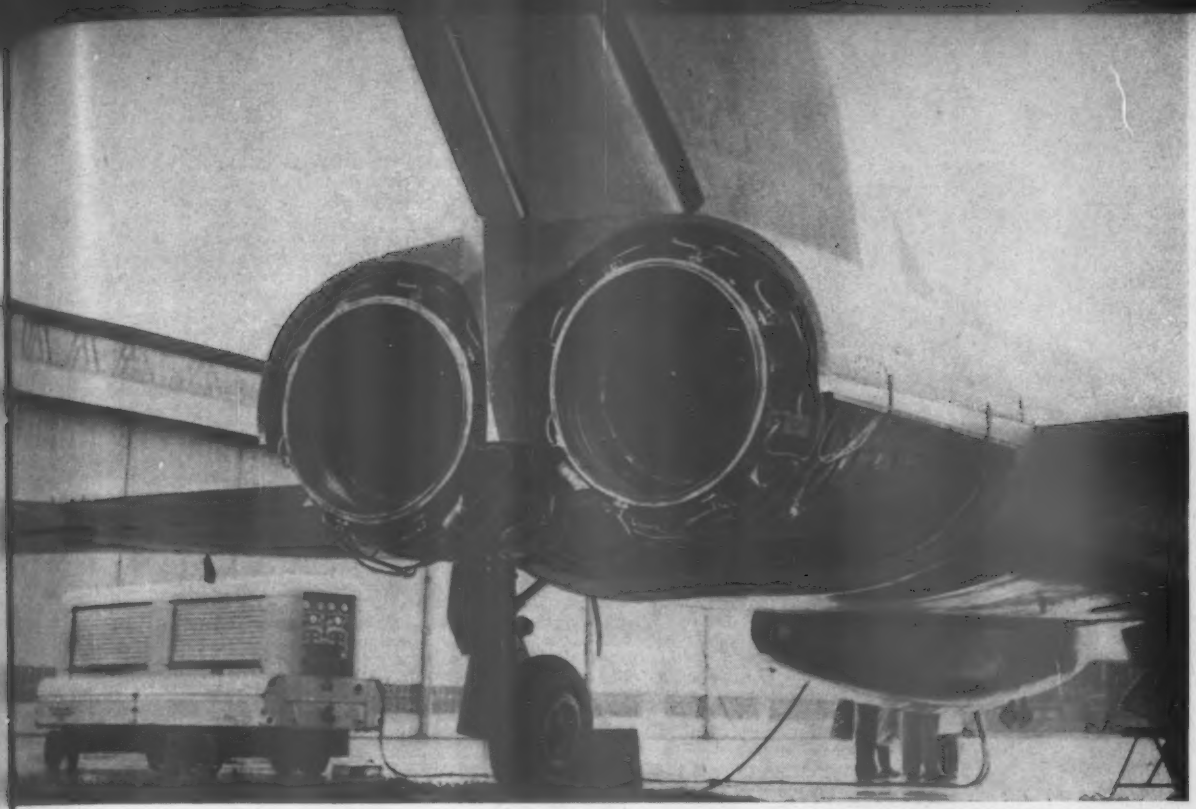
OFFICIAL confirmation that a jet-flap research aircraft is being developed by Hunting Aircraft has now been given. The aircraft is designated ER.189D and it is to be powered by a single Bristol Siddeley Orpheus turbojet; it was first mentioned in THE AEROPLANE of Apr. 25, 1958.

The Hunting ER.189D is being designed for full-scale flight tests of the jet-flap principle, which was the subject of a research programme by the National Gas Turbine Establishment between 1952-54. The jet flap is based on ducting the exhaust jet of a gas-turbine engine to the trailing-edge of an aircraft's wing and ejecting it through a narrow slit along the trailing-edge. In this way the jet can be used for propulsion and can be deflected to form a "jet flap" of high-velocity gas which allows lift coefficients up to more than 10 to be achieved.

Originally it was intended that all the propulsive jet of an aircraft should be ejected through the jet flap. But later N.G.T.E. work has shown that it is preferable to use only part of the exhaust jet in this way.

Latest N.G.T.E. thinking considers that the jet flap should

PILING UP HOURS.—The first Avro 748, which has completed some 300 hours of flight testing, is to be joined within the next few weeks by the second prototype, which was damaged by fire last year. **A note on 748 progress appears on page 138.**



SUPERSONIC POWERPLANT.—With a special reheat system, the de Havilland Gyron Junior DGj.10, will power the Bristol 188 supersonic research aircraft. These powerplants are now undergoing flight development tests in a Javelin airframe. More pictures and details are on page 135.

ideally be used in conjunction with turbofan engines; the cool by-pass flow would be ducted to the jet flap and the hot turbine exhaust used for propulsion in the traditional manner. This has the practical advantage that no very hot gas flows have to be ducted through the wing.

Division of engine thrust on the ER.189D probably depends on the stage at which the aircraft's design was frozen. The Orpheus is a pure turbojet and thus ducting the hot exhaust gas must have been a problem in the airframe design. Hunting Aircraft had prior experience of this problem in the development of its P.74 hot-jet tip-drive helicopter.

Bristol Aircraft may also have been involved in work on the aircraft since Hunting became a member of the British Aircraft Corporation. Its experience in fabricating heat-resistant structure for the Bristol 188 could well be useful.

No details are available of the ER.189D configuration, although it seems probable that it has a swept wing, because the most likely application of the jet flap would be to improve the low-speed performance of high-speed swept-wing aircraft.

It is believed that the original intention was to modify a Jet Provost for jet-flap research, but that it soon became clear that a completely new design was necessary. Use of a single engine must have helped to simplify the design of the ER.189D; with two engines, duplicated jet-flap ducting would have been needed to cope with an engine-out case.

Aviation Electronics in 1960

DURING the past year military and civil aviation orders have again accounted for a substantial proportion of the estimated gross output of the electronics industry in this country. Looked after by the Electronics Engineering Association, this capital goods side of the industry is now rated at about £175 million—more than 2½ times the figure for 1950.

In aviation electronics, the outstanding technical achievement of 1960 is considered to be the completion of the development of the R.A.E. Autoland system for military application. Now adopted for operational use by Bomber Command, this automatic landing system is being evaluated by the United States (See THE AEROPLANE AND ASTRONAUTICS for Jan. 20) and on the Continent. It has been further refined recently and interest is now reported to centre on using a sufficiently narrow-beamed and accurate ILS system to replace the use of leader cables.

Dominating the aviation field both commercially and technically is radar. One technical step forward has been a development promising to give a range improvement of at least 25% on 50-cm. equipment. Another development is the production of the first high-power klystron designed specifically for use in commercial radar. This valve is being employed in 50-cm. radars on order for Denmark, India, Italy and for the U.K.

Among the larger radar orders is one for a 500-kW. installation costing about £177,000 for Fiumicino Airport, Rome. Following the supply of high-power 50-cm. radars to Wellington and Ohakea airfields, New Zealand, a third contract calls for the installation of two further surveillance radars at Momona Airport, Dunedin, worth £80,000. The Yugoslav Government has also ordered U.K. surveillance radar for the new international airport at Belgrade.

Weather radar is another important factor commercially, and one company belonging to the E.E.A. has received orders for eight installations in New Zealand and the Southern Pacific. A cyclone-warning radar system for Australia is due for delivery later this year and other weather radar installations have been exported to the Argentine, Germany, Brazil, Sweden, Southern Rhodesia, France and the United States.

New unclassified airborne electronic equipment orders include civil and military contracts for over £116,400 worth of jet-pipe temperature control amplifiers and a £250,000 initial order for an airstream direction indicator to be fitted to all R.N. Scimitars,

Matters of Moment . . . .

Sea Vixens and Buccaneers. Recent M.o.A. contracts for the Transport Command Argosy C.1 include a £552,000 Doppler navigator order and a further £100,000 worth of ADF equipment.

The Association's annual review for 1960 states that some of the larger and more sophisticated aircraft now carry up to £250,000 worth of electronics.

Heaviest Sputnik Yet

HARDLY had the cheering subsided in America over the successful launching of a space-chimpanzee, a Samos reconnaissance satellite, and the first Minuteman ICBM—all in one week—when attention was turned on the 6½-ton experimental spaceship which the Russians placed in orbit on Feb. 4.

Bearing in mind that this vehicle is no less than 6½ times heavier than the Mercury capsule in which it is hoped to send America's first human astronaut into orbit using an Atlas booster, the weight-lifting disparity between contemporary U.S. and Soviet rockets can be appreciated. Not only does the Soviet multi-stage booster exceed the payload capability of the projected Atlas-Centaur employing a high-energy liquid-oxygen/liquid-hydrogen top stage (7,400 lb. into a 300-mile orbit), but its payload capability is already up in the region where it would be possible to put men into space in lifting vehicles approaching the concept of Dyna-Soar. If the booster employs conventional propellents, the thrust of its initial stage must be in the 1,000,000-lb. class.

The latest sputnik entered a higher close-orbit than its 10,221-lb. predecessor, Sputnik VI, launched on Dec. 1. This contained two dogs Little Bee and Little Fly; its apogee was 165 miles, perigee 117 miles, and period 88.6 min. Subsequently, the Russians announced that it had "descended along an incorrect trajectory" and it was presumed to have burned up in the atmosphere.

Sputnik VII did better. At its nearest on the day of launching, it was 139 miles and at its most distant, 204 miles. Its period was about 89 minutes. But the orbit is still too low for the vehicle to remain in space for long.

So far as its intended mission is concerned, no indication had been given as we close for press beyond the fact that, as Prof. Georgi Pokrovsky put it, the spaceship contains "many more instruments of all kinds than have been sent into space before."

Twenty-four hours after the launching, listening stations could not pick it up in Britain but a West German observatory in Bochum said it had received strong signals on the afternoon of Feb. 6. The signals were described as "ultra-high bleeps intermittently separated by deeper tones."

A Loss to Canadian Aviation

WE regret to record the death, on Feb. 3 in Canada, of Mr. W. D. Hunter, F.C.A.I., technical director of The de Havilland Aircraft of Canada, Ltd. He was one of the pre-war members of the de Havilland design team at Stag Lane and Hatfield and had been closely associated with the company's Canadian affairs since 1941.

After serving an apprenticeship with the Graham White Aviation Co. from 1913 to 1918, Mr. Hunter went to Kennedy Aviation as a designer until 1920 when he moved to Vickers at Barrow-in-Furness where he worked on the R80 airship and the Vigilant flying-boat. In 1922 he joined the Fairey design team and in 1925 started his long association with de Havillands.

He had a good deal to do with the design of the Mosquito and when it was proposed that these aircraft should be built in Canada he was given the task of adapting it for production at the de Havilland factory at Downsview near Toronto. He joined the board of D.H. Canada as technical director in 1945 and since then has played an important part in the development of the company and its designs as represented by the Chipmunk, Beaver, Otter and Caribou.

Kerosene—Lord Brabazon's Motion in the Lords

THE current controversy on the respective merits and shortcomings of kerosene and petrol fuels for jet airliners was carried an important stage further on Feb. 1 when LORD BRABAZON OF TARA initiated a debate on the issue in the House of Lords. In consequence a technical study is to be undertaken forthwith. Lord Brabazon was supported by LORD SHACKLETON and LORD OGMORE. EARL BATHURST, Lord-in-Waiting, replied for the Government to the debate.

LORD BRABAZON, who began by posing to the Government the question "What price safety?", developed his argument in that lucid and fluent style to which he is happily addicted. Sharply delineating his own terms of reference he confined his case to the consequences which have been shown only too often to follow rupture of fuel tanks and spillage of fuel as a result of damage sustained in a bad take-off or landing.

He hammered home his main contention which was that when a quantity of fuel is discharged to the atmosphere and comes into contact, by itself or its vapour, with a potential igniter—be it sparks, hot metal, electrical energy or any other—then, if that fuel be kerosene, it may not catch fire at all, and if it does so the rate of flame propagation is slow; but, if that fuel be petrol, it is far more likely to catch fire, and thereafter a holocaust ensues in a flash.

Lord Brabazon adduced the fact that our two Corporations—B.O.A.C. and B.E.A.—use, and have always used, kerosene, as also does R.A.F. Transport Command. On the other hand, certain substantial overseas airlines—he instanced Sabena, T.W.A., Trans-Canada and Pan-American—have standardized on petrol in spite of its attendant risks. As possible reasons influencing this choice he suggested a minute saving in cost or—more likely—persuasion by the oil companies; he was inclined to think the latter had an axe to grind in that at present they extracted more petrol than kerosene from a barrel of oil.

He realized that it was difficult or impossible for the Government to move legislatively in the matter at this juncture, short of refusing certificates of airworthiness for operation on petrol. This would be tantamount to declaring it dangerous to fly on petrol, which would be ridiculous in view of the fact that more than half of the aircraft flying today, being still piston-engined, demand its use.

However, he felt that it was a good thing to air this question in the House, so that intending passengers should realize the danger and perhaps help to bring it home to airline operators by inquiring what fuel was to be used when buying their tickets. He asked the Government to say that, within the limits of his motion, there is extra danger in using petrol instead of kerosene.

EARL BATHURST said that, although certain operational advantages had been claimed for petrol, there was no appreciable difference in the safety of the two fuel types in flight. However, he stated, the Government is satisfied that *prima facie* kerosene may offer a better prospect of escape after an accident in taking off or landing, and accordingly, in order to ascertain the significance of the safety margin conferred, the Minister of Aviation has personally instituted a detailed technical study of the whole question. He agreed that internationally the Government's only weapon was persuasion, and its effectiveness would depend principally upon the results of the technical study.

Now the subject matter of this dispute, although shot through with technical terms and considerations, is by no means recondite. On the contrary, it is unnecessary to be a fuel or any other sort of technician, or even skilled in matters aeronautic, in order to understand its essence. Within Lord Brabazon's motion the question is as simple as this: If I am unlucky enough to stand, sit, kneel or lie in or near a puddle of fuel, or be splashed with it, and there is a chance that the fuel may catch alight, which fuel will give me the better chance of living to fly another day—petrol or kerosene? Every householder and every motorist knows the answer, and, despite the worst that forced education of the masses can accomplish, so do most schoolchildren.

That much of the findings of the technical study can be confidently prejudged. The terms of reference of the study group need not be wide, nor their work complicated, nor their deliberations protracted. Obviously, to resolve the issue beyond a peradventure between the two fuels, they must go outside Lord Brabazon's limiting case; they must take and sift evidence for and against each fuel on every consideration: safety on the ground, safety in the air, maintenance schedules, thermal efficiency, range, payload, price, availability and so on. Pros and cons there will be, at any rate among considerations other than safety, and theirs will be the task of collating the several arguments, and assessing their comparative values. Certainly they will keep an open mind before reaching their findings, and the public must do the same.

The Minister of Aviation's move is welcome and encouraging—but, if it be fair to prognosticate, the public will require some pretty weighty and hitherto unpleaded advantages for the use of petrol to reconcile it to acceptance of the built-in hazard constituted by its presence in the circumstances envisaged by Lord Brabazon. If petrol loses the day, the Government can certainly use the verdict as a deterrent—but the public can implement it as a veto.—O.W.H.C.

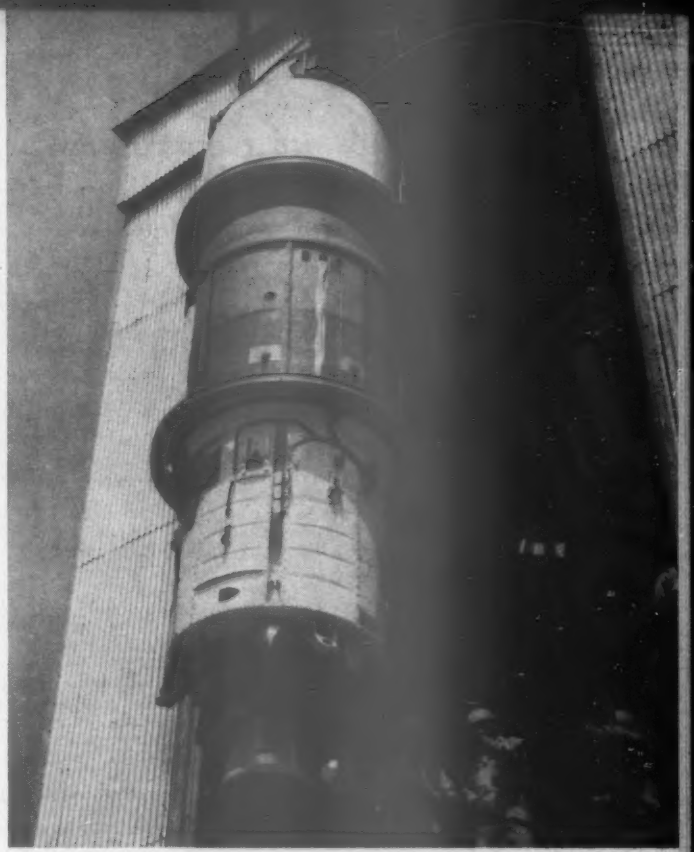
First Reconnaissance Satellite

WHETHER it was by accident or design, the first successful launching of a Samos reconnaissance satellite by the U.S.A.F. on Jan. 31 from Point Arguello, California, was effectively "smokescreened" by the launching, the same day from Cape Canaveral, of the Mercury capsule containing Ham the chimpanzee astronaut. Samos was launched from the west-coast site at 20.22 hrs. (G.M.T.). The announcement that it was successful came about two hours later, but such was the publicity accorded the activities at the Cape that the presence of the first experimental reconnaissance satellite in polar orbit passed almost unnoticed.

In view of President Kennedy's declaration that there would be no resumption of U-2 flights over Russia, the future of the Samos project had been in some doubt. One previous attempt had been made to launch a Samos satellite on Oct. 11 last year, but a fault in the Atlas-Agena booster prevented an orbit being achieved. Samos II, however, appears to have struck a good orbit which has an apogee of about 350 miles, a perigee of some 300 miles and a 95-min. period.

As in the case of the Discoverer and Midas satellites, the entire Agena second stage goes into orbit. This has an overall length of 22 ft. and a diameter of 5 ft. Empty weight of the vehicle in orbit is 4,100 lb. It is orientated with a nose-down attitude to the ground after it has been established in orbit.

The payload, of unstated mass, includes experimental photographic and related test equipment; this is believed to have provision for tape storing individual TV pictures for transmission to ground stations. Later in the Samos programme, it is planned to incorporate ejectable capsules to permit the use of conventional high-definition cameras and the recovery of exposed film (see "Recoverable Satellite Projects," THE AEROPLANE AND ASTRONAUTICS, Dec. 9, 1960, p. 761). Eastman Kodak are to supply the photo-intelligence equipment.



Right, Samos satellite (Agena A vehicle) being prepared for launching at Point Arguello, California.

Supersonic Engine Testing

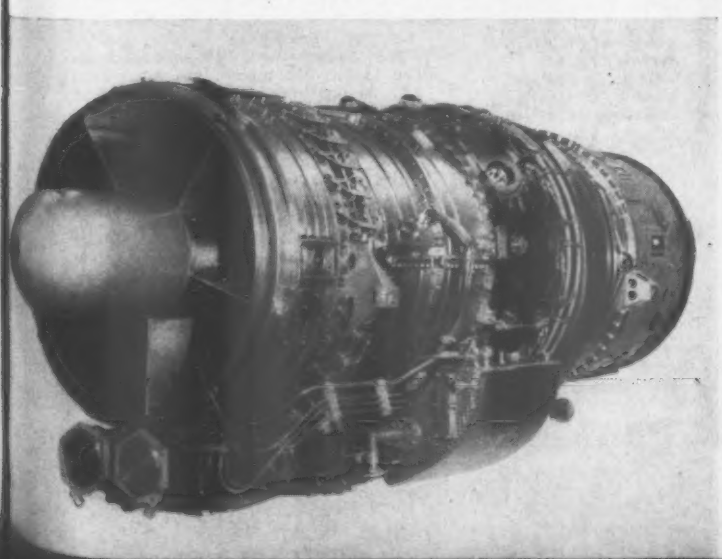
AS a necessary step towards the Bristol 188 all-steel supersonic research aircraft, which is expected to make its first flight within the next 2-3 months, a pair of Gyron Juniors of the type to be used has been installed in a Javelin for flight development. This aircraft made its first flight on Jan. 31 at Hatfield in the hands of Mr. J. Nicholson, chief test pilot of the de Havilland Engine Co. The conversion of the Javelin into a Gyron Junior test-bed was done by Napiers at Luton.

The engines concerned are DGJ.10s which develop a basic dry thrust of 10,000 lb. at sea level; with reheat they are capable of producing 14,000 lb. at sea level and more than 20,000 lb. at 36,000 ft. at speeds above Mach 2.5. The DGJ.10 is the first British turbojet engine that has been specifically developed for operation at speeds of this order. Static testing of the engine has already been initiated in the high-altitude, supersonic test chamber at the National Gas Turbine Establishment at Pyestock.

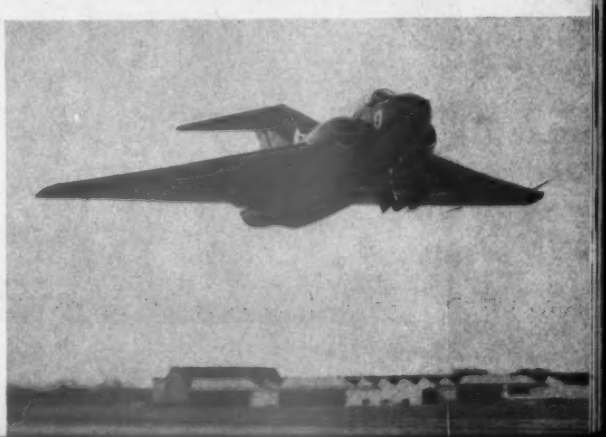
It is basically similar to the earlier versions of the Gyron Junior—such as that used in the Blackburn Buccaneer for the Royal Navy—but it has been modified and developed to cater for the high inlet temperatures and the added structural stresses imposed by supersonic flight. This has dictated, for example, the use of steel and titanium for the compressor end of the engine; a fuel-cooled oil cooler for the lubrication system has also been made necessary.

For the reheat system, which operates at a temperature of 2,000° K. and employs a variable-geometry convergent/divergent exhaust nozzle, the control system provides simultaneous control of the exhaust nozzle geometry, the compressor air bleed, and the fuel flows to the engine and the afterburner. The exhaust nozzle itself is of the multi-petal type and is designed so that its full "open" diameter does not exceed the general envelope geometry of the engine. For subsonic/transonic speed, the nozzle shape is purely convergent; it is made parallel for speeds up to Mach 1.4 with reheat; and opened up to become fully divergent for flight with reheat at higher speeds.

Overall length of the DGJ.10 with the reheat tailpipe is 191.0 in. and its basic diameter is 32.3 in. With the reheat pipe, the maximum diameter is 36 in.



Intended for the Bristol 188 supersonic research aircraft, two de Havilland Gyron Junior DGJ.10s (left) have been installed in a Javelin for flight testing. This Javelin test-bed (below) made its first flight on Jan. 31.



Aviation News in General

SPEY PROGRESS.—First run of the Rolls-Royce Spey engine was made last December. This by-pass engine, formerly known as the RB.163, will power the de Havilland Trident airliner which is on order for B.E.A.

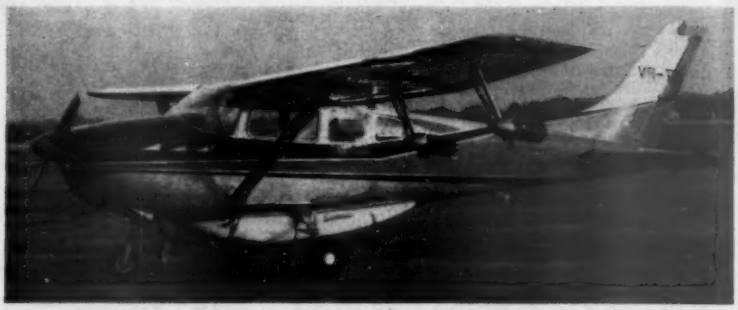
AIRCRAFT FOR GHANA.—Ghana has ordered eight Caribous and 12 Otters from D.H. Canada. The first Caribou is due for delivery in November and the first Otter next month. De Havilland already has orders from Ghana for 14 Beavers and 12 Chipmunks.

SWISS ATARS.—The Swiss Government has decided that the 100 Mirage III fighter to be built under licence in Switzerland will have French Atar turbojets rather than Rolls-Royce Avon RB.146s. It is reported as stating that the Rolls-Royce engine was not yet sufficiently tested and its use could cause a further delay in licence production of the Mirage. But Swiss observers will attend demonstration flights of the Avon-engined Mirage.

ASTAZOU-ALOUETTE.—On Jan. 31 at Le Bourget was the initial flight of a Sud Aviation Alouette II fitted with a Turboméca Astazou gas-turbine. The helicopter was flown by M. Coffignot, and among its three passengers was M. Szydlowski, President of Turboméca.

SUPERSONIC MERGERS? — Mr. Donald Douglas (Jnr.), president of Douglas Aircraft, has said that the cost of developing supersonic airliners may force "closer co-operation or outright mergers" in the U.S. aircraft industry. His company thought that development of a supersonic airliner would cost $500 million and each aircraft would cost up to $25 million.

KATANGAN JETS.—Reports from Leopoldville (later denied) indicated that four Dassault Mystère jet-fighters had been purchased in France for the Katangan Air Force. They were to be air-freighted from Toulouse to Katanga in a Stratocruiser operated by Seven Seas Airlines, and were said to be awaited by Belgian pilots. Aircraft of the Katangan Air Force, which hitherto has operated only a handful of communications and transport types, were previously reported to have dropped light bombs on Manono and other towns where pro-Lumumba forces had assembled.



SPRAYER FOR ARUSHA.—Recently bought from Airwork Services, U.K. Cessna distributors, by the Colonial Pesticide Research Establishment, this Cessna 182 has been specially fitted with Micronair rotary atomizers and a fibreglass chemical tank for aerial spraying. It is to be based at Arusha, Tanganyika, on experimental blight-control duties.

BETTER CL-44.—Canadair has announced range and speed improvements in the performance of the CL-44 as a result of recent flight-test measurements. Compared with original performance guarantees, the range is better by 6% (320 miles) and the speed by 3½% (13 m.p.h.).

FIAT FIRST.—A 30-min. first flight was made on Jan. 26 by the Fiat 7002 helicopter. Powered by a Fiat 4700 turbo-generator, the rotor is tip-driven by "cold-jets."

SCOTTISH AVONS. — The Scottish factories of Rolls-Royce, which are already responsible for the manufacture and overhaul of all military and civil Avon turbojets, will progressively take over Avon engineering development.

DART HOURS.—At the end of January, Rolls-Royce Dart turboprops had completed 14¼ million hours in airline service.

U.S. ACCELERATION.—In his State of the Union message on Jan. 30 President Kennedy announced that he had ordered stepping up of the Polaris submarine programme; more units would be built and would enter service at least nine months earlier than planned.

LIFE IN CARAVELLE. — Lear CIS-100 integrated flight equipment (LIFE) has been fitted in the General Electric-owned Caravelle now undergoing flight test at Edwards A.F.B. with CJ-805-23 turbofans. CIS-100 is used in aircraft operated by Piedmont, Ozark and Allegheny Airlines but has not previously been fitted in a Caravelle.

BENDIX DOPPLER.—Swissair and S.A.S. are to install the Bendix DRA-12 Doppler radar and CPA-24 computer system in their DC-8C and Convair 990 fleets. Evaluated by S.A.S., the system provides heading, course deviation and distance-to-go information.

ANTI-MISSILE.—A Hawk SAM intercepted and destroyed a Corporal SSM at White Sands, New Mexico, on Jan. 24. This is the first time it has intercepted such a high-speed ballistic missile; in earlier tests Hawks have destroyed the short-range Little John and Honest John unguided rockets.

UP-RATED.—The U.S.A.F. is to use a modified version of the Titan II "storable" ICBM for initial flight tests of the Dyna-Soar boost-glider instead of Titan I. This will permit a heavier test-vehicle.

I.A.F. CONGRESS.—A date has now been fixed for the XII Congress of the International Astronautical Federation. It will be held in Washington between Oct. 2 and 7, being followed immediately in New York by the American Rocket Society's "Spaceflight Report to the Nation" from Oct. 9 to 13.

VARIABLE CAMBER.—Differential variation of pitch on the tandem blades of this Hamilton Standard 15-ft. dia. propeller has the effect of varying its camber. It is claimed that for a VTOL aircraft the variable-camber propeller would allow a 50% increase in payload or a 40% increase in range. Developed under U.S. Navy contract, the propeller is being tested at Wright-Patterson A.F.B.

Commercial Aviation Affairs

BALPA FLIES THE ARGOSY. — A BALPA evaluation team made a flight assessment of the A.W. Argosy on Jan. 27, including the control characteristics during the approach to the stall; instrument approaches; overshoots and engine failures both at VI and on the approach. The team, which will submit its report to the makers and to the BALPA executive, comprised Capts. M. W. Broom, A. Spooner and R. I. Hill and Messrs. D. H. Lambert and L. F. E. Coombs.

L.A.P. CHANGES.—A high-speed turn-off (the first to be constructed at L.A.P.) is now in use for aircraft using runway 10L and bound for the Central Area. A new taxiway has also been constructed between runways 23L and 28R so that these runways may be used simultaneously.

DECCA FOR BAGINTON.—Coventry aerodrome has been equipped with Decca 424 airfield control radar in anticipation of increased traffic and to meet B.E.A. requirements when Coventry is used by the Corporation as an alternate for Elmdon. Baginton, at which a 5,300-ft. runway, with approach lighting, was laid down last year, already has CR/DF.

CARAVELLE SALES.—Sud-Aviation last week confirmed orders for a total of 14 Caravelles from three airlines, all of which had previously announced these purchases. The orders were from S.A.S. for four more to be leased to Swissair: from Alitalia for six, making a total of 14; and from Iberia for four Caravelle 6Rs, with an option on four more. Firm orders for the Caravelle now total 116.

RINGWAY SERVICES.—B.O.A.C. is to discontinue its Boeing 707 services through Ringway Airport while the interim lengthening of the runway is in hand. Sabena will continue services with reduced payloads and increased weather minima and all its services through Manchester will stop at Shannon to refuel before going on to New York. The Manchester City Council has now approved the scheme to extend the main runway eventually to 10,500 ft.

NEED FOR DME.—The need for distance measuring equipment on all high-speed aircraft operating in high traffic density areas and eventually on all aircraft operating IFR will be the subject of a conference to be held by the F.A.A. on Mar. 22. All interested parties have been invited to this meeting.

JERSEY DECCA.—Decca Mark 10 navigators and flight logs will be fitted in the six Handley Page Herald 200s ordered by Jersey Airlines.

INDONESIAN ACCIDENT.—For the second time in less than two weeks a DC-3 of Garuda Indonesian Airways is reported to have crashed on a scheduled service. It was flying from Surabaya to Balik Papan on Feb. 3, with 21 passengers and a crew of five. On Jan. 24, the 21 occupants were killed when their DC-3 crashed on Mt. Burangrang.

RUSSIAN AID.—Photographed at Dakar Yoff airport recently were the first of Ghana Airways' six Il-18s (9G-AAI) and an Avia 14P Salon presented to the President of the Republic of Guinea (3X-PRG). The latter aircraft (top picture) is a Czech-built variant of the Ilyushin Il-14, with wing-tip fuel tanks and an executive interior.

News About People

WOODFORD VISITOR. —Air Marshal Sir Edward Chilton, A.O.C.-in-C., Coastal Command, recently visited Avro's. He is seen with (left to right) Mr. A. Sewart, Sir Roy Dobson and Mr. S. G. Joy.

MASTER PILOTS. — GAPAN has awarded Master Air Pilots Certificates to Mr. D. A. D. Cather, Canadian Department of Transport inspector; Capt. A. L. A. Whitham, Chief Pilot of MacRobertson Miller Airlines; and Capt. W. H. A. Wood of Malayan Airways.

ALUMINIUM SALES.—Mr. T. K. Singer has been appointed general sales manager of James Booth Aluminium, Ltd.

PROPULSION PROFESSOR. — Dr. A. H. Lefebvre, at present deputy head of the combustion department of the aero-engine division of Rolls-Royce, Ltd., has been appointed professor of aircraft propulsion at the College of Aeronautics, Cranfield. He succeeds Prof. A. G. Smith and takes up his new post on Apr. 1.

B.O.A.C. LOSS.—On Jan. 31 Capt. T. H. Farnsworth, previously chief of flight operations, left the service of B.O.A.C. after 25 years with the Corporation and Imperial Airways. A presentation (of a Georgian design mahogany desk) was made by his many friends and associates within the Corporation.

WATT MEDALLIST. — Prof. Dr. Theodore von Karman, chairman of AGARD, has been awarded the 1961 James Watt International Medal in recognition of his important contributions to the advancement of mechanical engineering science, particularly in the field of aeronautics.

1960 GAPAN AWARDS

THE Guild of Air Pilots and Air Navigators has made the following awards for 1960: The Brackley Memorial Trophy goes to Capt. J. S. Shephard of T.E.A.L.; The Cumberbatch Trophy to the R.A.F. Institute of Aviation Medicine, Farnborough; The Derry and Richards Memorial Medal to Lt. Cdr. M. J. Lithgow, deputy chief test pilot, Vickers-Armstrongs (Aircraft), Ltd., and the Award of Merit to Gp. Capt. H. A. Purvis, test pilot, A. and A.E.E., Boscombe Down. The awards will be presented by H.R.H. the Duke of Edinburgh at the Guild banquet to be held at the Guildhall on Apr. 11.

SIR PHILIP GAME.—It is with regret that we record the death, on Feb. 4, of Air Vice-Marshal Sir Philip Game, G.C.B., G.C.V.O., G.B.E., K.C.M.G., D.S.O. After transferring from the Army to the R.F.C. in 1916 he had a distinguished career in Service aviation until he retired from the R.A.F. in 1929. He was later appointed Governor of New South Wales and when his term of office expired in 1935 he succeeded Marshal of the R.A.F. Lord Trenchard as Commissioner of the Metropolitan Police—a post he held until 1945.

Air Transport

News of the 748

DELIVERIES of Avro 748s to Skyways, which had originally hoped to have them in service on the Coach-Air services this summer, are not now likely until September. The certification programme has suffered a setback as a result of damage to the second prototype in the fire at Chadderton last year, and is not now expected to be completed until the middle of this year. As Skyways' utilization of the Avro 748 will depend heavily upon the seasonal holiday peak, the company will undertake route proving and training during the winter and will put the 748 into service in March, 1962. B.K.S. will be the second operator to receive Avro 748s, towards the end of this year.

Repairs have now been made to the second prototype, which should fly during March. It will be closely followed by the first 748 off the production line. Production of a batch of 60 aircraft has been authorized, and seven of these are now on the line in various stages of construction. Meanwhile, the first prototype has completed about 300 hours, and this flying, say the makers, has indicated no need for significant changes on the production model.

Merger Approved

THE Civil Aeronautics Board has acted with unusual speed to approve the United/capital merger proposal. United had indicated that it must have an answer by Feb. 1; a preliminary decision was announced by the C.A.B. on Jan. 31, confirming that no major obstacle was likely to be encountered if the plan proceeded.

Three conditions were listed by the C.A.B.: to protect the jobs of employees of both companies; to limit, for rate-making and accounting purposes, the valuation of the assets acquired from Capital by United; and to protect the interests of Mohawk and Allegheny Airlines in certain markets.

United has said it will retain 41 of Capital's 56 Viscounts for the time being, and several of the surplus 15, nominally returned to Vickers under agreed terms, have already been sold to other operators. Eventually, United is expected to dispose of the remaining Viscounts in order to achieve fleet standardization. Capital had at one time ordered seven Convair 880-Ms and five Electras; it is unlikely that United will reinstate these orders, but additional orders may be placed for Boeing 720s and/or Caravelles for use on Capital routes. Two Boeing 720s have been operated by Capital on lease from United since last month, and United had already indicated it would double its order for Boeing 727s, from 20 to 40, if the merger were approved.

Moving House at L.A.P.

AFTER the end of this month K.L.M. will be using L.A.P. Central as its passenger terminal for all services. Since the opening of the Central Area buildings K.L.M. has continued to process its European passengers with the long-haul passengers on the North side.

The same principle is being followed in this move, which is being made in expectation of the 1962 opening, to all operators, of the new Intercontinental Building in the Central Area, and the closing of L.A.P. North. B.O.A.C. will be the first to move into the new building later this year, when initial accommodation becomes available.

LONDON INTERCONTINENTAL.—The new long-haul passenger building which is now under construction in the L.A.P. Central Area. B.O.A.C. is to start to use it later this year and the foreign-flag long-haul carriers are to move in during 1962.

It will be interesting to see whether any of the long-haul airlines follow (or are allowed to follow) K.L.M. and whether the Central Area complex will be able to handle the increased traffic. K.L.M. is one of the busiest carriers to use L.A.P., with up to 30 flights a day in the peak period of the year, and has, no doubt, as the Airport of London's oldest airline (Croydon, 1920-39, and 1945-47; L.A.P. since 1947), certain "grandfather" privileges.

Protecting the Public

ONE of the repercussions of the recent New York and Munich disasters—in which aircraft crashed into built-up areas—has been a special session of the German equivalent of the airport owners' association (the Arbeitsgemeinschaft Deutscher Verkehrsflughäfen) to discuss the implications. The meeting was attended by the Munich airport authorities, and by representatives of the Federal Ministry of Transport and the Institute of Air Traffic Control.

The meeting, after pointing to the need for a programme to protect local populations, recommended the formation of an expert committee for each civil airport in Germany. These committees would work out proposals for the development of approach, take-off and fixed flight-path procedures on which there would be a minimum amount of flying over densely populated areas, and for the increase of the minimum altitude over certain areas from the present 300 m. (984 ft.) to 600 m. (1,968 ft.). The airport authorities would then use these proposals as a basis for action.

It was agreed that, if this action is to be successful, additional navigation aids, including ILS, will be required and that the location of some military airports and training areas might need to be reconsidered.

Air Union Slow-down

IN contrast to earlier and optimistic predictions of eventual integration among the four Air Union partners (Sabena, Air France, Alitalia and Lufthansa), their attitude seems now to be very much more cautious. A 30-year (not 99-year) convention is likely, however, to be signed by the four governments concerned and, in due course, Air Union may have the character of a corporate body—but it will never be an integrated operating company in any literal sense of the words.

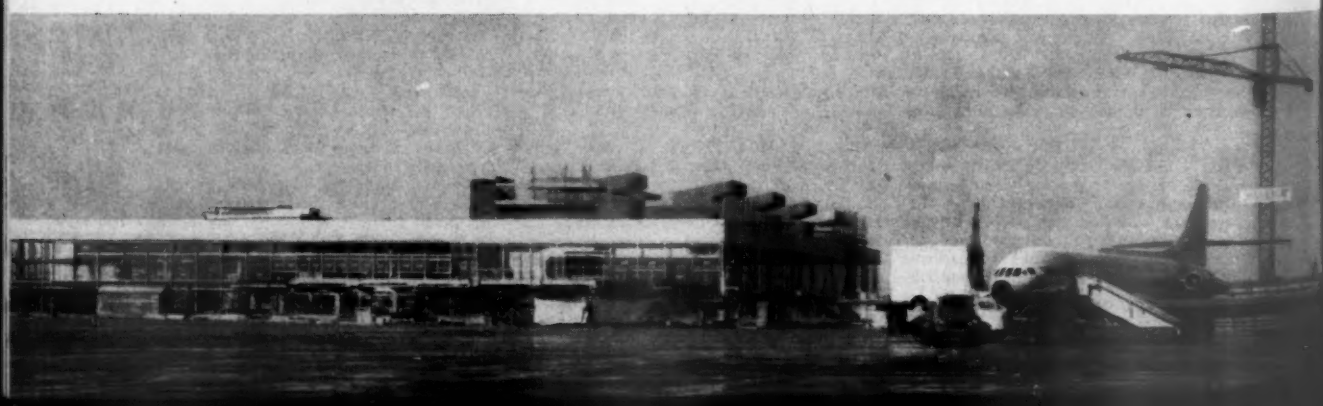
Operations will be continued by the member airlines under the terms of the resolutions and directives drawn up by a central organization. When (and if) necessary, the four carriers will form subsidiary companies to meet Air Union requirements. The central body will be the Executive Committee, on which there will be two delegates from each of the member companies. This committee will supervise a series of departmental and technical committees. The controlling body will be a General Assembly—with five delegates from each carrier and including representatives of the four civil aviation authorities.

The political situation in Africa has obviously complicated the work of agreement. This area is served not only by Air France and Sabena, but by other national carriers. It is unlikely that there will be any permanent solution for Africa within an Air Union framework.

Another problem for Air Union has been the development of an agreed system of financial accounting to be adopted during the initial period. In fact, the individual member companies' target traffic quotas for the future bear little relation to present shares. For 1959 Air France's share was 47% (50% in 1958); Lufthansa's was 20% (17%); Alitalia's was 18% (15%), and Sabena's was 15% (18%). Agreed target quotas when a joint production of 2,400 tonne-km. had been reached were: Air France, 34%; Lufthansa, 30%; Alitalia, 26%; Sabena, 10%.

Certainly there does not appear yet to have been co-operation in fleet planning between the four airlines. Though most of the orders for modern equipment were placed long before Europair (the forerunner of Air Union) was instigated, some

(*Continued on page 139*)



Mr Davies

(Manager, Agricombine Air Division)

buys a cropsprayer

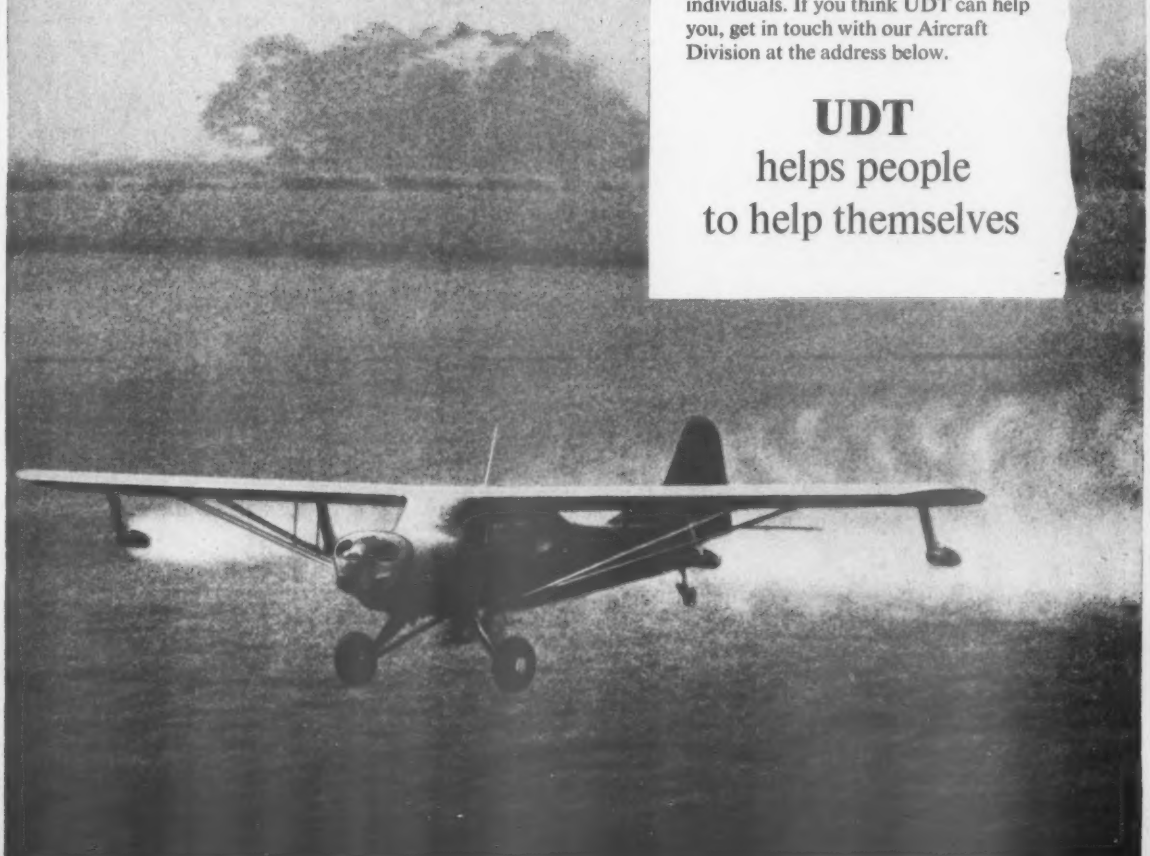
'Aerial top dressing' (that's the correct phrase) can save a farmer thousands of pounds. Trouble is, the capital cost of the equipment is prohibitive—out of the question for most individual farmers.

Mr Davies' company was started to solve just that kind of difficulty. It makes available earthmoving plant, pumps, trenchers and so on to farmers who have no all-the-year-round need for such things. This cropsprayer is just the latest item in Agricombine's comprehensive range of equipment, held ready for when the occasion arises.

Like all their equipment, Agricombine's cropsprayer is being bought through UDT. They reckon that most of their equipment pays for itself—and more—over the months. So the purchase of this plane becomes a simple entry in the company accounts, paid for over a period with no strain on capital.

UDT is ready to help with all branches of flying—buying aircraft for business or commercial use, for flying clubs or private individuals. If you think UDT can help you, get in touch with our Aircraft Division at the address below.

UDT
helps people
to help themselves



UNITED DOMINIONS TRUST (COMMERCIAL) LIMITED · UNITED DOMINIONS HOUSE · EASTCHEAP · LONDON · EC3

C

Deputy Technical Sales Manager

Expansion of our Trident sales effort and the evaluation of future projects require the creation of this new appointment.

Qualifications

Preferred age bracket—33-40

Engineering degree, or equivalent, preferably aeronautical

He must have had several years experience leading a group in aircraft performance, route and cost analysis and allied fields with either a major aircraft company or an airline.

Technical ability, initiative, personality and leadership are extremely important.

Duties

He will be responsible to the Technical Sales Manager for the day-to-day running of the Sales Engineering Department and will :-

(a) Supervise technical selling of all de Havilland civil aircraft at Hatfield and abroad.

(b) Feed back results of technical discussions to Sales and Design Departments.

(c) Co-ordinate Market Research activities.

He must be prepared to travel.

Applicants earning less than £1,600 are unlikely to be suitable.

A brief account of qualifications for this appointment should be sent to:

The Personnel Manager (Ref. 125)

The de Havilland Aircraft Company Limited

Hatfield, Herts.

Member Company of the Hawker Siddeley Group

Air Transport . . . .

(*Continued from page 138*)

rearrangement of this equipment might have been expected. At present, for long-haul operations, Alitalia has DC-8s while the other three members have Boeing 707s; for intra-European services Alitalia, Air France and Sabena have Caravelles, but Lufthansa is still uncommitted; and Sabena is the only one without Viscounts. At this stage—with the DC-3 as the only aircraft type used by all four airlines—a co-operative equipment policy does not seem possible, though there may well be some interesting decisions when the time comes (soon enough) to place orders for next-generation short-, medium- and long-haul aircraft.

Heralds for Canada

AN order for two Handley Page Herald 200s, with an option on six more, has been placed by Maritime Central Airways and their associate Nordair, Ltd. The order follows an evaluation of several possible replacements for the DC-3s now used by these two operators. Mr. C. F. Burke, managing director of M.C.A. and administrative vice-president of Nordair, is reported to have said that the Series 200 Herald was the aircraft best suited to the airline's particular requirements and was "the obvious answer to the DC-3 replacement on feeder-line or medium stage length routes."

M.C.A. flies a network of scheduled services in Canada's north-east, serving Nova Scotia, Prince Edward Island, Newfoundland and going as far north as Frobisher. The fleet includes a Viscount, a DC-4 and four Curtiss C-46s in addition to four DC-3s. The company also flies supply missions to the Pine Tree Chain and Dew Line radar early-warning systems. Nordair, which purchased the Wheeler Airlines' heavy transport division last year, flies scheduled services from Montreal to the north, and has five C-46s, seven DC-3s, six DC-4s and six Catalinas.

The Herald 200 was announced last September and is in production for Jersey Airlines. It is a little longer than the original Herald Series 100, and can accommodate 50 passengers. Orders for the Herald now total 12, including the three to be purchased by the Ministry and operated by B.E.A.; the contract for these has still to be signed. Other orders are for six from Jersey Airlines and for one from North-South Airlines of Leeds-Bradford Airport.

Pushing the Vanguard

WITH four Vanguards delivered and a fifth en route, Trans Canada Airlines put the new Vickers turboprop into service across Canada on Feb. 1. Planned service points were Montreal, Vancouver, Toronto, Winnipeg, Regina and Calgary. Services will build up steadily between now and August (see our issue for Dec. 16, 1960).

As a preliminary to putting the Vanguard into use, T.C.A. has conducted an enterprising and extensive programme to indoctrinate its own staff, travel agents and the travelling public. This programme culminated in a series of proving-cum-demonstration flights over part of the transcontinental network between Jan. 15 and Jan. 22. In two static showings of CF-TKD, the first Vanguard delivered, 16,300 visitors walked through the cabins—10,000 at Toronto and 6,300 in Calgary. At these two points and at Ottawa, 14 courtesy flights were made, carrying 96 passengers each time.

Stops of an hour or less were made at Winnipeg, Edmonton, Saskatoon and Regina, to familiarize T.C.A.'s local ground services personnel with the vital actions needed to turn the aircraft round at a traffic stop. At Toronto, a full load of 96 passengers was disembarked and another 96 embarked in seven minutes, while at Winnipeg a spare Tyne was removed from the rear freight hold, by personnel dealing with the aircraft for the first time, in 11 minutes.

A correspondent who was with the aircraft for some of these demonstrations, reports that the decor and spaciousness of T.C.A.'s 96-seat layout (50 economy five-abreast, 46 first class, four abreast) made a big impact. He writes that "the colour schemes, mood lighting, short seat backs and the general feeling of space and vision are all paying off in passenger appeal. The Viscount windows, one feels, are taken for granted.

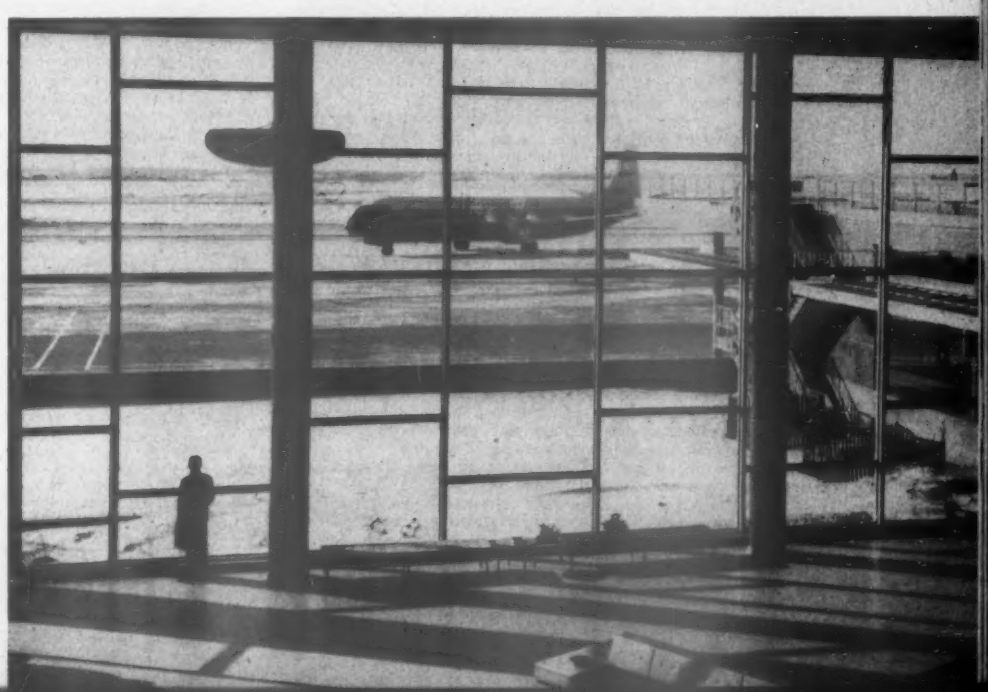
"T.C.A.'s Vanguard is now not only a 'pilots' aeroplane' but also a 'stewardesses' aeroplane.' Cabin crew reaction is particularly favourable; the four compartments, the two-way service in first class and the airsteps are the major plus points. Four cabin crew are carried on Canadian domestic flights (no alcohol), plus a purser on the Caribbean services."

B.U.A. Bids Again

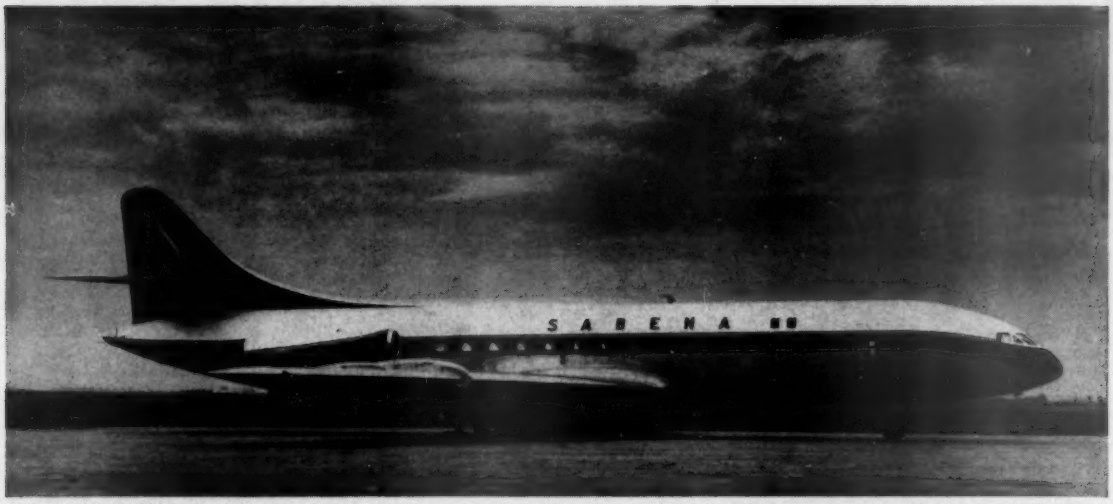
LICENCES for two more long-haul scheduled services in competition with B.O.A.C. are being sought from the Air Transport Licensing Board by British United Airways. Details of the applications appear in *Civil Aviation Licensing Notices No. 4*. One service a week would operate over the route London (Gatwick)-Singapore, with optional stops at Istanbul, Teheran, Karachi, Delhi, Calcutta and Bangkok, and a second weekly service over the same route would be extended to Hong Kong and Tokyo.

The application specifies the use of Britannias or DC-6Cs at first and VC10s later, and is for all classes of passengers, including Skycoach (at 18% below established IATA rates) on the cabotage sectors London-Singapore-Hong Kong. B.O.A.C. at present has a monopoly of all classes of service on these routes, which it flies in pool with Qantas and Air India International. The Corporation has already confirmed its intention of entering objections to the B.U.A. applications for three routes to Africa and the Cunard Eagle applications for trans-atlantic route rights.

Licensing Notices No. 4 also includes applications from Silver City for two scheduled passenger (tourist-class) services. One is for a seasonal service between Prestwick and the Isle of Man, using Dakotas or Bristol 170s, and the other for a year-round service from Ferryfield or Manston to Basle, using Dakotas or Hermes.



CANADIAN SCENE.—In the course of the demonstrations described on this page, the first T.C.A. Vanguard visited Ottawa, where this picture was taken. Vanguard services were started by T.C.A. on Feb. 1.



NEW CARAVELLE.—Sud-Aviation last week announced new orders for the Caravelle bringing the total to 116 (see page 137). The first Caravelle VI, with 12,200 lb.s.t. Avon 531 turbojets, has recently been delivered to Sabena. Other airlines which have ordered this variant are United and Iberia.

Air Transport . . . .

The Air-freight Business

THE IATA cargo conference in Paris, which opened on Jan. 23, appeared, late last week, to have reached a deadlock. The conference has been primarily concerned with the North Atlantic and the initial Press release from the Association said that the main purpose of the conference was "to review together the thorough studies that have been made by individual companies of the potential market and the experiences obtained with the very reduced commodity rates already in existence."

Less official sources have suggested that there might be very serious efforts to simplify and reduce cargo rates, and it has been reported that, not unexpectedly, Seaboard and Western Airlines (the only exclusively all-cargo scheduled operator on the Atlantic) would fight hard for reduced rates in relation to its fleet of five CL-44s which are due to be introduced in July.

No doubt, if this is so, the proposals will have been opposed by a number of carriers. As we said in this column on Oct. 24, 1960, the fact of IATA's closed rate system probably means that "breakthrough rates may have to wait until a sizeable number of airlines have acquired correspondingly economic freighters." Reports last week from Paris suggested that Pan American and T.W.A. had supported Seaboard's proposed reductions, but that there had been strong opposition from some of the European carriers.

According to *Aviation Week*, Seaboard's proposed Atlantic tariff structure is based on a "volume incentive pattern." In other words, the bigger the single load the lower the rate. A 2,200-lb. shipment from New York to London would, for instance, cost 78 cents per lb. by comparison with the present standard rate of 83 cents for consignments of 1,100 lb. or more. A shipper taking the whole 65,000-lb. payload capacity of a CL-44 would pay only 28 cents per lb. This certainly seems to be a rational approach.

Something About Aeroflot

ALTHOUGH the more knowledgeable seekers after the statistical, comparative and other new information about Aeroflot would have learnt very little from last week's Institute of Transport group lecture,* a few points did emerge.

The occasion was, in itself (to use an overworked aviation word), a breakthrough. Capt. Yarotski, Aeroflot's U.K. general representative, not only lectured, but submitted himself afterwards to questions from a packed (and overflowing) theatre. Most of these questions were parried—but the answers were given with such disarming humour and courtesy that no one could feel any serious disappointment.

Among the not-quite-new facts to emerge were these:—

Aeroflot's domestic route network covers about 300,000 km. (186,000 miles) and the international network about 65,000-70,000 km. (40,000-45,000 miles). The Aeroflot administration —which looks after the whole of air transport and ancillary operations—is broken down into regional divisions (see our issue of Jan. 27, p. 88). The Tu-124 is a two-turbofan, medium-short-range (600-mile), 40-passenger aircraft, and the long-haul turboprop Tu-114 is now in regular service. A five-year plan (1960-1965) involves a sixfold increase in traffic and the building or rebuilding of 90 airports. There is, at present, no special emphasis on cargo, which "should go by train," and there are no all-cargo aircraft, but regular mail and newspaper flights are made to Arctic and other "outpost" communities. Pilots' flight-time limitations involve something of the order of 6-7 hr. in the air at a time.

The questions to which no factual answers were given included the very natural one about the numerical composition of the Aeroflot fleet. All that could be gathered was that published estimates (our own included) have been somewhat wide of the mark. One supposes that such information has strategic value. If so, other airlines had better start to cook their equipment books; at present the fleets of these airlines can be counted to the last DC-3 (or Li-2).

The lecture and question session were educative in a special way. Those who could get in to the packed Queen's Building lecture theatre will have left it with some incidental understanding of the reasons for the differences in thinking between the people of the two worlds. In a completely socialized environment a particular transport or other operation is planned with a set productivity programme and the necessary system is then organized and staffed accordingly. Words like "fares," "load factors" and "utilization" can have no objective meaning—though someone, no doubt, is counting the cost of the operation in terms of overall value to the community.

To the West, with its methods of assessing detailed profit and loss (and acting accordingly), the system seems to invite the risk of inefficiency on a really grand scale. In the meantime, it will be an aid to mutual understanding if we try not to think about Aeroflot (the Chief Administration of the Civil Air Fleet under the Council of Ministers of the U.S.S.R.) as a "business" in the literal Western sense of the word—though there are many signs of a changing outlook.—H.A.T.

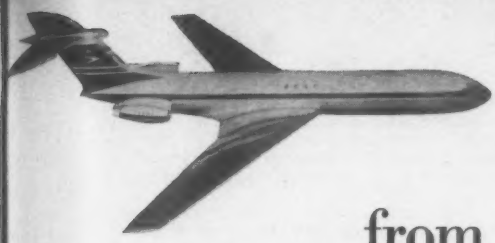
* "Air Transport in Russia Today," by Capt. G. A. Yarotski. An Institute of Transport (West Middlesex Group) lecture at London Airport on Jan. 31.

The Advisory Committees

FOR the record, the names of the members of the Welsh and Northern Ireland Advisory Committees for Civil Aviation are listed below. The constitution of the Scottish Committee was noted on Jan. 27, when we also explained that each of these committees will be consulted, as appropriate, by the Air Transport Licensing Board in relation to regional licence applications.

Welsh Committee: Sir Miles Thomas (chairman); Lord Dynevor; Sir David Treharne Llewellyn and Messrs. T. W. Benbow, O. G. Foulkes, M. R. L. Hayes, Quinton Hazell, E. H. Hickery, W. T. Mainwaring Hughes, Vernon Lawrence, L. R. P. Pugh, R. G. Robinson, P. J. Smith and David J. Young.

Northern Ireland Committee: Wg. Cdr. R. C. Preston (chairman); Sir Graham Larmor; Sir Basil McFarland, Lt.-Col. D. J. Christie, Alderman C. F. Milligan, Dr. W. F. Bryson and Messrs. Max Eitel, J. W. Haughton, G. Martin Johnston, N. Kennedy, J. P. Mackie, C. A. Nicholson, T. W. Price and D. H. Stevenson.



The VC10

from the Operator's Viewpoint

In this, the second of a series of articles dealing with Vickers' second-generation turbojet, the market prospects, performance features and basic design philosophies are discussed. The flight aids, systems and services will be described in detail in later articles.*

THE term "second-generation" has, during the past few years, been applied somewhat loosely to several civil aircraft types, but such a qualification is really applicable only to aircraft which are basically "new" in terms of overall design philosophy and performance.

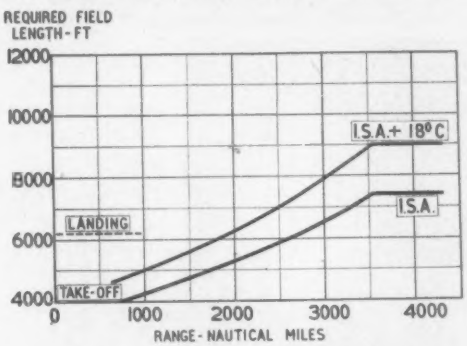
In fact, short of the big jump forward into the era of supersonic capability, it is difficult to do much better than to match present turbojet speed and load-carrying performances. But it is obviously possible to offer something much better in the way of runway performance, low-speed handling, developed operational features and (if only as a by-product) passenger comfort. This is what the designers of the VC10 have set out to do, using the newest aerodynamic information and improved, integrated systems.

Assuming that the VC10 is, from these aspects, a generation ahead of existing subsonic turbojet transports, what is the likely market? First of all, it must be taken for granted that there will always be subsonic requirements. Not only is it likely that subsonic seat-mile costs will continue to be effectively lower than those for supersonic aircraft, but subsonic aircraft will always be required for stages which are too short, or are otherwise unsuitable, for supersonic operations.

It remains to be seen how far the promise of a supersonic transport "just round the corner" will influence airline re-equipment policy. Obviously this promise will be psychologically disturbing for managements—and may even prevent them from daring to commit themselves to the purchase of additional long-haul subsonic turbojets. But with increasing traffic, such a standstill policy cannot be maintained for long. It seems that, when more is known about the practical prospects of specific supersonic projects, there will be an accepted need for realistic co-operative thinking among the airlines so that they can plan ahead more freely.

For a very long time to come—national and regional financing problems being what they are—there will, in any case, be a need for big-capacity, medium- to long-haul aircraft which meet moderate field-length requirements and have appropriately good low-speed handling characteristics.

So, in addition to a steady demand for a faster, bigger-capacity replacement for the present medium-stage, medium-performance turbojets, there may be a continuing slow round of steady big-jet buying during the 1960s and the early 1970s.



The VC10's sea-level airfield requirements for different stage distances with maximum payload in normal and 91°F temperature conditions. Fuel reserves assume two hours' holding and a 5% tolerance.

Whether or not the VC10 can take a lion's share of these markets depends on a number of factors—including the ability, or otherwise, of the present long-haul turbojet manufacturers to continue to develop their existing designs and to keep their production lines going for another decade or more.

The fact is that British (and European) aircraft manufacturers have had to accept the realities of an existing situation and to plan their production on a flexible, relatively small-scale basis. They are thus in a better position than their U.S. counterparts to maintain economically a comparatively slow production-rate over long periods. This advantage can obviously be exploited.

Another important factor in assessing future market prospects is that of airport noise rules—which will certainly become more rather than less restrictive in the future. No one knows what the present restrictions at London and New York may be costing some of the airlines in the way of additional refuelling stops and even of payload.

Assuming, as we must, that the take-off restrictions will remain and that the practice of noise rule-making will spread to the majority of international airports, then the optimum take-off and initial climb performances of turbojet transports will need to be tailored accordingly. There will no longer be any question of designing or operating on the supposition that all the available concrete will be used, and the aircraft with the better fundamental take-off and climb performance will have the advantage.

Undoubtedly the existing turbojets, unfashionable in layout though they may come to appear, have useful prospects of low-speed performance development with the aid of such devices as blown flaps, but, with the more than a head start of a clean wing, the VC10 should be able to stay ahead. The blown-flap (or boundary layer control) technique—which is likely to be applied more rationally to short-medium-haulers with high relative landing weights—could be developed for use with the VC10 if competition demanded it. The grouped rear-engined layout has certain specific advantages, as well as disadvantages, when designing any fail-safe system of artificial lift augmentation.

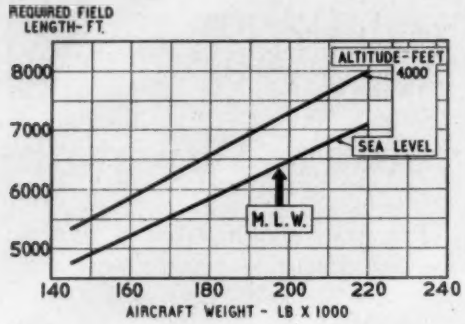
More important for the prospective operator are the advantages offered by a fully integrated flight control system with coupled approach facilities, automatic throttle operation, automatic flare-out and, eventually, automatic landing. The immediately obvious advantages are that the VC10 will be able, eventually, to operate to lower weather minima and that the operator will be able to schedule services in nearly all conditions. But even more important is the fact that all approaches and landings will be predictable.

The use of automatic control as a matter of course during let-down and final approach will make these difficult phases of flight as predictable as any other—with reliable shortening of airborne times and a steady improvement in schedule regularity. In due course it might even be practicable for the airworthiness authorities to relax their landing-distance requirements for suitably equipped aircraft with approved systems.

The VC10, in its initial form, was the direct result of B.O.A.C.'s requirements for Eastern Hemisphere operations. These requirements demanded an aircraft which could carry high payloads over all appropriate stage-distances whilst operating into and out of comparatively small airfields and those situated at more than 5,000 ft. a.m.s.l., or with midday temperatures rising to I.S.A.+20°.

The Atlantic-capability stretching was the direct result of design work to meet these difficult cases. It was found that

* First of series appeared on Nov. 18 last.



Landing distance requirements (60% factor) of the VC10 at different weights and for sea-level and 4,000-ft. airfield elevation. Maximum landing weight is 199,000 lb.

the wing area required was such that there was space potential for 13,000 lb. more fuel than was required on any "Empire" stage, and that relatively small further increases in area and thickness would make it into a non-stop North Atlantic aircraft. The VC10, as finally ordered by the Corporation, was an optimum design to give the best average fleet economics.

The good expected field performance is directly attributable to its clean wing and the consequent advantage of full-span leading-edge slats and flaps. Some theoretical comparisons were made in our issue of Aug. 26, 1960 ("Rear-engined Arithmetic"). In general terms it can be said that, assuming a landing weight in the 180,000-240,000-lb. bracket, the extra lift of a clean as opposed to a podded wing allows the weight to be increased by about 25,000 lb. for the same approach speed (and same landing distance), or, at the same landing weight, reduces the optimum approach speed by about eight knots.

In practice, since a rear-engined aircraft has a higher structure weight, the bonus may be equivalent to about 20,000 lb., or 6-7 knots. If, as on the Atlantic route, no such bonus is required, then advantage is gained in the reduction of relative wing area and, consequently, of cruising drag and fuel consumption.

In simple figures the overall design philosophy has resulted in an aircraft which, in its initial all-purpose form for B.O.A.C., but with R.Co.42/3 engines, will have a 3,700-n.-mile still-air range with a full (38,000 lb.) payload, a normal maximum cruising Mach number of 0.88 (504 kt.) at 35,000 ft. and above, and the ability to operate from sea-level runways between 7,000 ft. and 9,000 ft. in length regardless, within reason, of temperature.

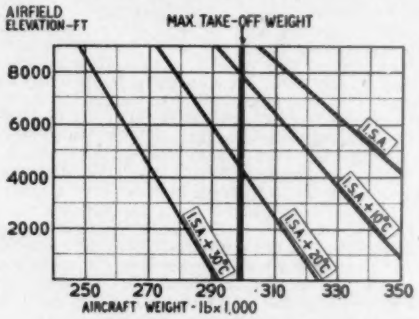
Since field performance was the basis of the requirements round which the VC10 was designed, let us deal with this in broad detail. At typical landing weights the approach speed will be between 115 and 120 kt. For a 2,000-n.-mile sector (with 5% tolerance and two hours' holding fuel) when carrying a maximum payload, the sea-level take-off field-length requirement will be 5,300 ft. in I.S.A. conditions, or 6,300 ft. in I.S.A. + 18° C. (91° F.). The equivalent field lengths at maximum take-off weight will be 7,300 ft. and 9,000 ft. At sea level the take-off weight will be unrestricted at temperatures below I.S.A. + 27° C. and at 4,000 ft. elevation there will be no limitation below temperatures equivalent to I.S.A. + 21° C.

Landing distances from a screen height of 50 ft. and using 60% of the runway at maximum landing weight (199,000 lb.) will vary between 6,400 ft. at sea level and 7,300 ft. at an aerodrome elevation of 4,000 ft.

As might have been expected with Vickers' background of transport aircraft experience, the importance of quick turn-rounds was recognized from the inception of the design. The various servicing points are arranged so that simultaneous work is possible and all essential points are on the starboard side, with passenger doors on the port side, forward of the wing.

Normal servicing, including that of the toilets and galleys, can be done without interruption whilst other loading and unloading operations and refuelling are being completed. The rear freight door is aft of the trailing edge, so this, with the forward freight-hold door (starboard), and the under-aircraft freight hatch can all be used conveniently whilst passengers are entering or leaving. During turn-rounds the trucks involved with cabin air conditioning and engine starting would be positioned aft of the trailing edge.

The VC10's control cabin has been designed so that the aircraft can be operated by a flight crew of three—two pilots and a flight engineer—but five permanent positions are provided, to allow for navigator and supernumerary pilot.



This weight/altitude/temperature graph shows how the VC10's maximum sea-level take-off weight is unrestricted at temperatures below I.S.A. + 27°C and is not limited below I.S.A. + 21°C at an airfield elevation of 4,000 ft.

Laid out with flight and systems presentations designed to the recommendations both of pilots' associations and of airworthiness authorities, the control cabin is roomy, adequately provided with accessible stowages for documents and personal crew effects, and provided with its own wardrobe and toilet facilities.

The second pilot's seat can be slid far enough rearwards for its occupant to be able, when necessary, to look after the engineer's controls and panels, which can also be seen from the captain's position. All appropriate systems controls and indicators are laid out and marked pictorially.

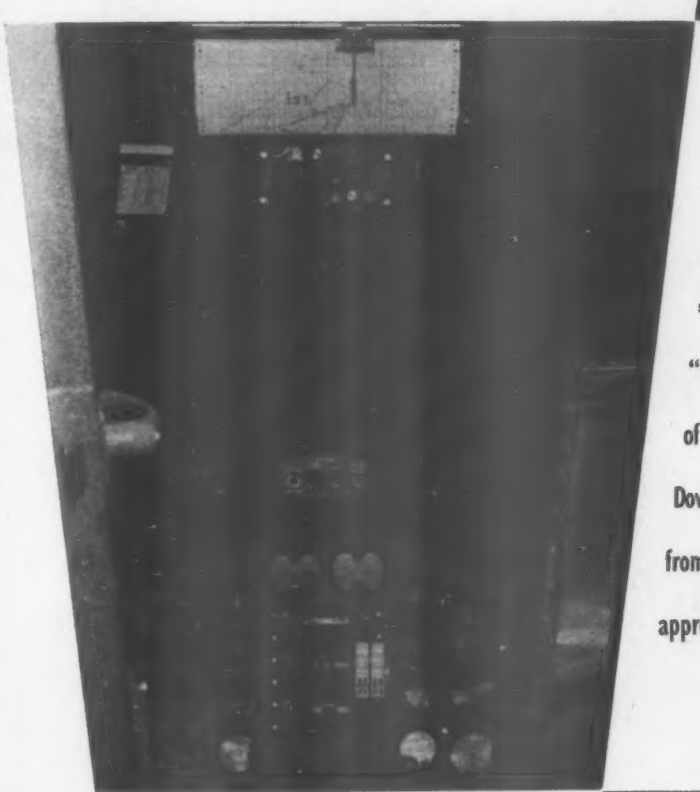
For an aircraft with a high maximum cabin pressure differential the screening and other fenestrated areas are large. There

(*Continued on page 143*)

This photograph, taken inside the mock-up of the VC10, shows the general layout of the roomy flight deck.

MR. J. C. BAMFORD, Chairman and Managing Director of J. C. Bamford (Excavators) Ltd says:

"We fitted Decca because we operate into many small, ill-equipped airfields all over Europe and we must be able to fly in any weather day or night, with the same regularity as from any major airfield".



Cockpit of the De Havilland Dove 8 owned by J. C. Bamford (Excavators) Ltd., showing the Decca Flight Log and Decometers. The installation consists of a Decca Mark 8 Receiver (½ ATR) and Computor (½ ATR), Flight Log and Receiver control boxes and display head, the total weight of all units being less than 45 lbs.

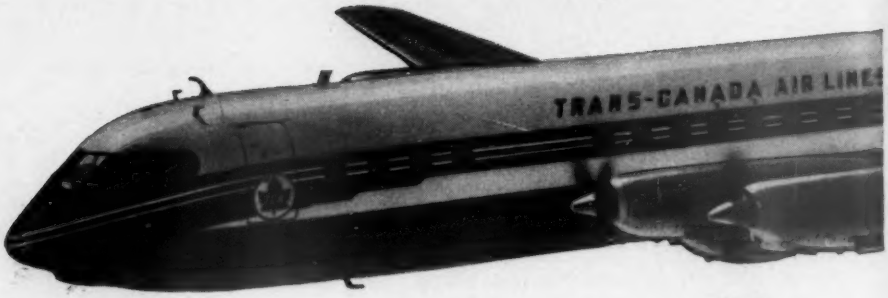
THE DE HAVILLAND AIRCRAFT CO. LTD., suppliers of the DOVE 8 aircraft, state:

"Decca is a proven system for the operator of executive aircraft such as the De Havilland Dove 8 who must frequently navigate away from airways and use airfields where approach facilities are often non-existent".

THE DECCA NAVIGATOR

for executive aircraft

THE DECCA NAVIGATOR COMPANY LIMITED LONDON



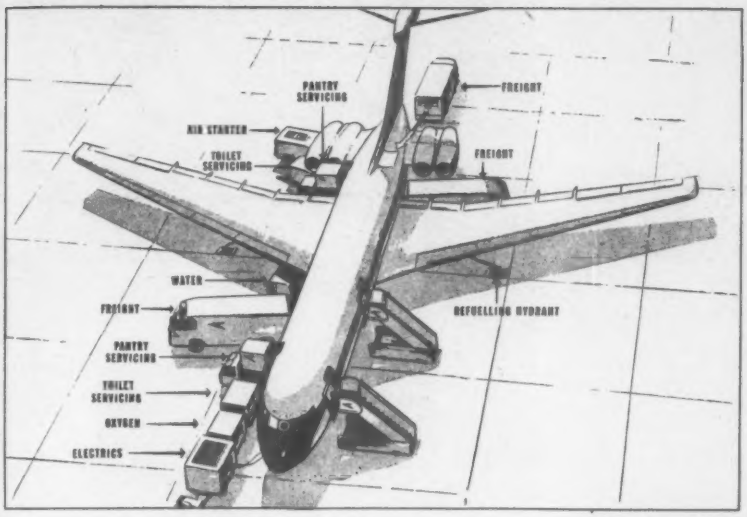
TCA VANGUARD fleet will land on Goodyear

Goodyear tyres, wheels, brakes and anti-skid equipment have been specified for T.C.A's fleet of Vickers Vanguard type 952.

GOODYEAR

AVIATION DIVISION

SERVING AVIATION THE WORLD OVER



This drawing shows how the ground servicing and freight loading vehicles could be grouped around the VC10, leaving the areas near the two passenger doors and their entry stairways entirely clear.

(*Continued from page 142*)

are nine main panels, covering about 31 sq. ft., and six "eyebrow" panels.

The details of the VC10's basic control and integrated flight system will form the subject of a later article in this series. It will be enough to say that the overall control system follows a philosophy in which, to give maximum safety, the various surfaces are split into separate portions and the control system for each channel is also split. Pitch and lateral controls each have four electrically and separately powered surfaces, supplemented respectively by hydraulically powered tailplane and spoilers; there are three electrically powered rudder surfaces supplemented by the aileron/spoiler combination. Independent duplication of power is provided for the spoilers, the leading-edge slats and the flaps.

There are four independent sources of electrical and hydraulic power, with duplicated distribution systems. For remotely possible final emergency, power can be supplied by ram-air-driven turbo-alternator and turbo-pump.

But the built-in advantages of the total flight-control system which are of day-to-day operational importance lie in its overall integration with two entirely independent auto-pilots, each with its own comparison monitor, and the facilities provided for automatic approach and flare-out—leading eventually to automatic landings. These features, when accepted and used to the fullest extent, are likely to change present-day ideas of regularity in airline scheduling.—H. A. TAYLOR.

European Traffic

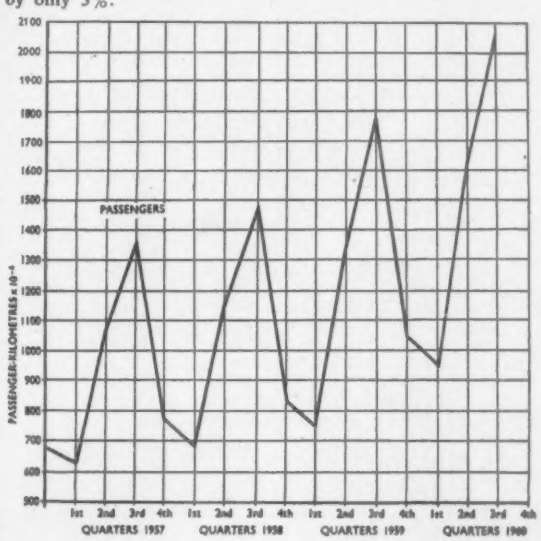
TRAFFIC statistics for the 11 major European airlines in the third quarter of 1960 have now been compiled and published by the Air Research Bureau, and are shown in tabular form here. The trends are indicated graphically.

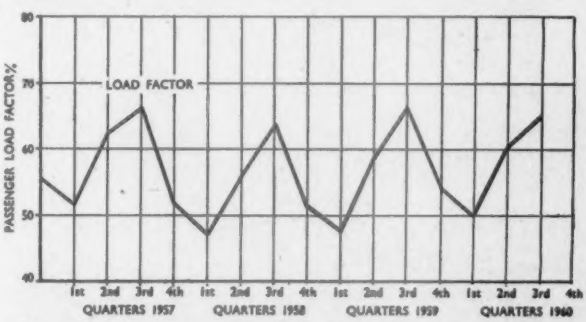
While the 16% rate of growth in passenger-miles was rather better than the World average, it was less satisfactory than in the previous quarter, when a 22% increase was recorded. On a moving annual basis, the rate of growth was again 19%, compared with 19% in the 12 months ending in June, 1960, 16% in the year ending March, 1960, and 13.3% in 1959.

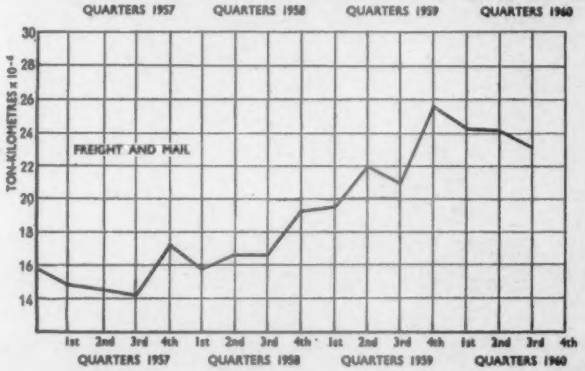
The rate of freight traffic growth appears, from the latest figures, to be slowing down. On a moving annual basis, this rate was 27% in the 12 months ending June, 1960, and 19% in the year ending September, 1960. The increase for the quarter was 12%, as it had been in the second quarter also. There were, however, increases of 55% and 47% respectively in capacity offered and freight carried on all-freight services, and 23% of all intra-European freight was carried on specialized freight aircraft in the third quarter. Mail ton-miles increased by only 3%.

	3rd Quarter		1960 as % of 1959	12 mths. ending		1960 as % of 1959
	1959	1960		Sept. 1959	Sept. 1960	
Seat/km. (mill.)	2,672	3,184	119	8,230	9,693	118
Pass./km. (mill.)	1,778	2,068	166	4,757	5,681	119
Pass. load factor % ..	66.6	64.9	—	57.8	58.6	—
Freight tonne/km. (mill.)	17.0	19.1	112	66.9	79.6	119
Mail tonne/km. (mill.) ..	3.9	4.1	103	16.3	17.7	109

Intra-European traffic includes all traffic carried on international routes originating and terminating within the European continent and countries bordering the Mediterranean. Airlines included in this survey are: Aer Lingus, Air France, Alitalia, B.E.A., Finnair, Lufthansa, Iberia, Icelandair, K.L.M., S.A.S., Sabena, and Swissair.







Rocket Motor Cases by Bristol Aerojet

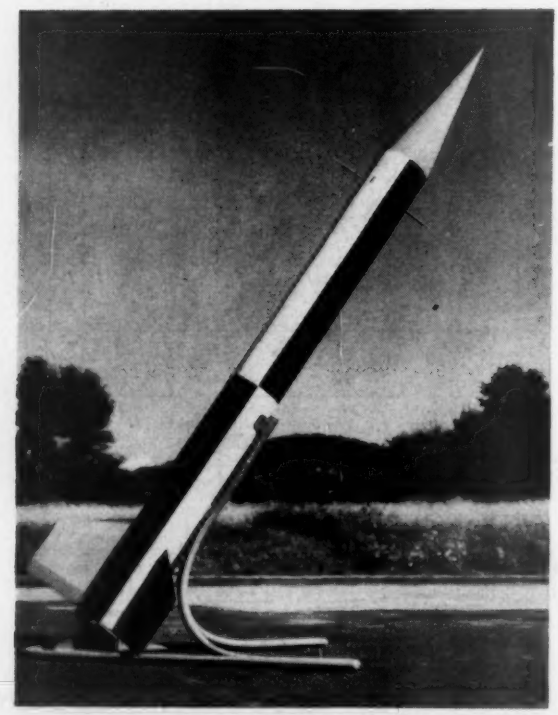
MOST of the motor tubes for British solid-propellent rockets are produced by Bristol Aerojet, Ltd., at its Banwell factory near Weston-super-Mare in Somerset. This applies both to boost and sustainer motors for surface-to-air, surface-to-surface and air-to-air missiles, as well as to the motors for research vehicles such as the Skylark sounding rocket.

But the company does not produce the solid propellents which fill the motor tubes. Because of their nature, the propellents used for filling these tubes are made only at Government establishments or factories operated under agency agreements with the Government.

Bristol Aerojet work on rocket-motor tubes goes back some 10 years to the time when Bristol Aircraft took over work in this field which was being done by British Messier, Ltd. The rocket-motor division of Bristol Aircraft was set up for this purpose. In due course it was transferred to the Banwell factory, which had been built during the War as a Bristol satellite factory for Beaufighter production.

Late in 1958 Bristol Aerojet, Ltd., was formed as a company in its own right following an agreement between the Bristol Aeroplane Co., Ltd., and the Aerojet-General Co. of the United States. Bristol Aerojet is owned 50% by Bristol and 50% by Aerojet, for whom it acts as agent in Britain. Under the agreement there are regular technical interchanges of information on unclassified subjects between the British company and Aerojet in the United States. Under Government sponsorship these are extended to classified subjects when this is required by a Bristol Aerojet project.

Today its main activity is the production of solid-rocket motor cases. But much of its work is devoted to developing new techniques and the production of development motors, as well as making those for missiles which are in full production. It also manufactures welded pressure vessels, mainly for aircraft and missiles, although commercial outlets are also being sought. In addition the company produces reinforced-plastic components such as rocket-nozzle venturis and pressure vessels. The company employs about 500 people and has its own research, design, development and test facilities in addition to its wide range of specialized equipment for the production of motor cases.



TEST VEHICLE—Bristol Aerojet has designed, developed and manufactured a range of solid-propellent test vehicles. These carry instrument payloads which are recovered by parachute.

BOOSTERS—Solid-propellent boost-motor tubes await dispatch from the Bristol Aerojet factory at Banwell.

At present most of these cases are produced from low-alloy steel sheet which can be heat-treated to give strengths up to 130 tons/sq. in. The material is cut to size on guillotines which will take sheets up to 12 ft. long and 0.25 in. thick. The sheets are rolled to form tubes and longitudinally welded. Following rigorous X-ray examination of the welds, the tubes are hydraulically stretch-formed in dies to their final dimensions. Forged thrust take-off brackets, thrust nozzles and end fittings are connected to the motor tubes by circumferential welding.

Welding techniques have been closely studied by Bristol Aerojet. Both manual and automatic welding are used. Argon-arc welding is widely applied and the quality of the welds is so good that the presence of welded joints can be neglected in design calculations. During tests to destruction the welded motor cases usually fail outside the weld region rather than at a weld itself.

Most of the motor cases produced by the company are for missiles and security limitations prevent any information being given about them. But there is not such strict security on the Raven solid-propellent motor which powers the Skylark upper-atmosphere rocket.

The Raven motor case forms the main body of the Skylark vehicle. It is about 15 ft. long and 17.4 in. in diameter. A composite case-bondable propellent is used, consisting of ammonium perchlorate, ammonium picrate and poly-isobutylene. Total weight of the motor is 2,200 lb. and its specific impulse is 177 sec. It gives a thrust of 11,500 lb. for 30 seconds.

Helical Welding

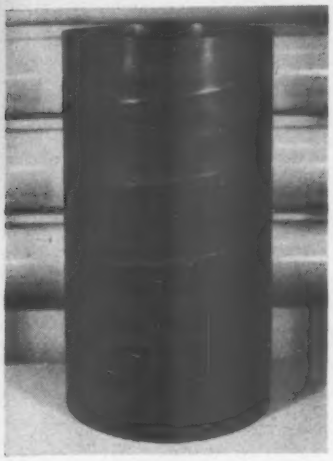
At present most motor cases are produced from rolled sheet which is longitudinally welded, although flow-turning is used to produce some motor tubes. The company has now developed a new technique which is faster, more flexible, and demands far less equipment than the wrap-and-weld method. This is the production of motor tubes from metal strip which is helically wound on a mandrel to form a tube and is simultaneously butt-welded.

With this technique tubes of considerable diameter and length can be produced in all weldable materials. Helical welding is unlikely to be economical for diameters below 3 in., but it is exceedingly attractive for large tubes, particularly those with very thin walls and in materials which are difficult to work. Welding speeds of up to 100 in. per minute are envisaged and one machine could produce tubes at the rate of up to 30 in. per minute when using strip equal in width to the tube diameter. In fact, the rate of production promised by this technique means that Bristol Aerojet could meet the current requirement for rocket-motor tubes very easily and the company is seeking other applications for its helically welded tube. Using

equipment now being installed, the company will be able to produce helically welded tube in diameters between 3 and 54 in.

When helical welding is used for rocket-motor production, dimensional tolerances and joint alignment are improved. Development work by Bristol Aerojet suggests that helical welding will rapidly supersede wrap-and-weld fabrication for all future motors and it may be introduced for current designs because of its greater accuracy. The use of steels with tensile strengths above 230,000 lb./sq. in. is facilitated by helical welding; high-strength rocket cases will almost certainly rely on this technique in future.

The technique is very promising for the production of tubes in Nimonic alloy and stainless steel. Both Bristol Siddeley and Rolls-Royce are considering its use for jet-pipes and afterburners. Airframe manufacturers consider that helical welding will be very suitable for producing thin-walled stainless steel

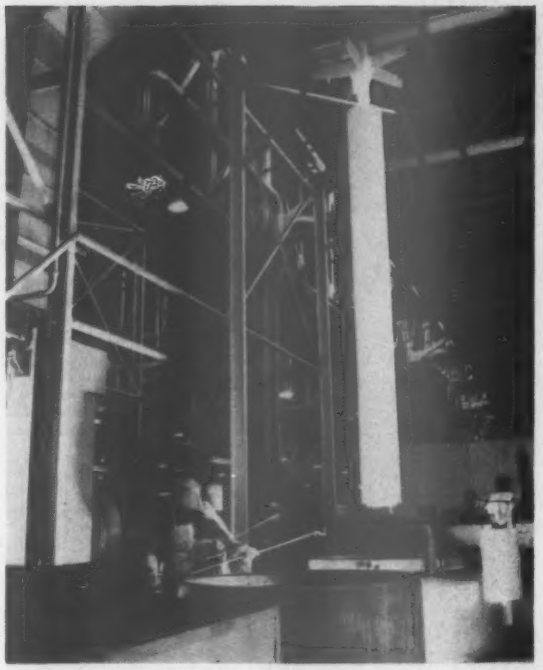


HELICAL TUBE—Rocket-motor tubes made from helically wound and welded metal strip are expected to supersede those produced by current techniques. This 17-in.-diameter tube was produced by helical welding of 6-in.-wide chromium molybdenum strip 0.048 in. thick.

ducts between 3 and 12 in. in diameter; these would be used as air-conditioning ducts. Other demands for this type of tubing are expected from the chemical and process industries.

Future Projects

As well as making rocket-motor cases and much of the associated hardware such as venturis and nozzles, Bristol Aerojet has been responsible for the design and manufacture of several rocket-motor test vehicles. As a private venture in this field



HEAT TREATMENT—Motor tubes up to 20 ft. long and 30 in. in diameter can be heat-treated in vertical furnaces at Bristol Aerojet.

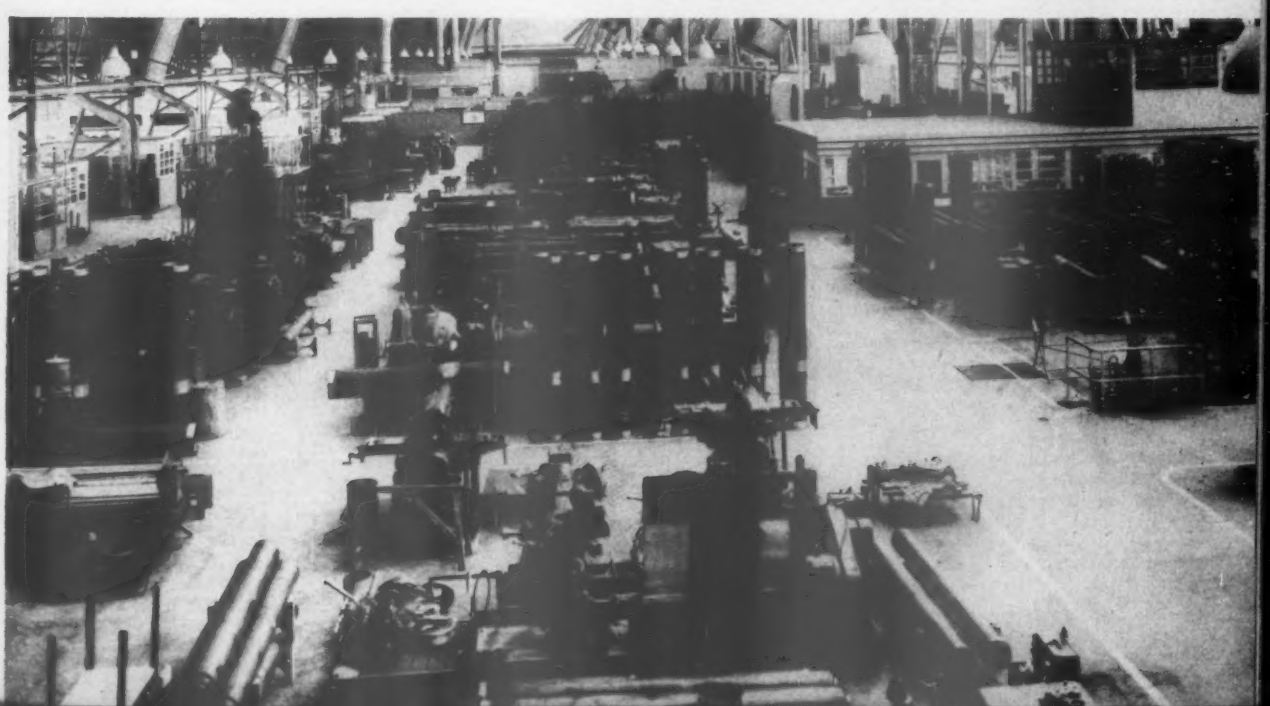
the company is designing a small meteorological rocket for high-altitude research. It would be capable of lifting a 10 lb. payload of instruments to a height of 200,000 ft.

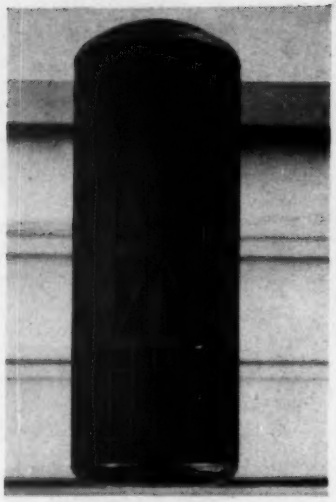
Research

Bristol Aerojet has a large staff of metallurgists and devotes considerable effort to research into the composition of steel alloys and the best techniques for using them in rocket-motor production. One technique it has developed is contour etching, which can be used to produce motor tubes with integral stiffeners. Motor tubes with etched waffle-pattern stiffening have been produced in this way.

The technique is also very suitable for pressure vessels because it can be used to reduce weight. If a component fails in fatigue at a weld under high alternating stresses, its endurance

MACHINE SHOP—A variety of rocket-motor tubes can be seen in this view of a Bristol Aerojet machine shop.





INTEGRAL STIFFENING.—Bristol Aerojet has developed chemical etching techniques for the production of integrally stiffened motor tubes. This sample shows ways in which the technique can be applied.

can be improved if it is made from thicker material which is chemically contoured on all surfaces except in the region of the welds. The best strength/weight ratio is achieved by reducing the material thickness to the point at which failure is transferred from the weld to the parent metal.

As a result of studying materials and techniques for producing thin-wall solid-propellent rocket cases, Bristol Aerojet has concluded that for many applications steel cases are superior to those made of titanium alloy or wound glass fibre. Much research and development work is being done on titanium fabrication and glass-fibre construction; these materials have great merit where their special properties can be exploited.

The company has an intensive research programme on the improvement of all materials used for rocket-motor case productions. The main requirements for the future are improved materials and more efficient techniques of construction.

The basic aim is to improve the purity of steels; at present failures are due to a lack of ductility caused by impurities such as sulphur and phosphorus in the steel. In collaboration with steel companies Bristol Aerojet is studying the effect of these and the other impurities which have a greater effect on strength than the alloying elements used in the steel. By specifying steels of higher purity it has been possible to produce motor cases with a tensile strength of up to 130 tons/sq. in., whereas a matter of three years ago strengths of only 80-90 tons/sq. in. were possible. The company's research programme suggests that in due course it may be possible to achieve steel strengths approaching 200 tons/sq. in. in the welded condition.

Close control at all stages of manufacture is essential if very high strength motor cases are to be produced. Low-impurity steel must be specified to reduce stress concentrations and increase ductility, and stringent quality control tests must be made on incoming material. Every effort must be made to eliminate surface and sub-surface defects and to prevent the introduction of hydrogen during welding, pickling and heat treatment. Detailed inspection, especially of welds, is very important.

Close control of materials and techniques at all stages has enabled Bristol Aerojet to improve the strength of its rocket-motor cases in the past. Even stronger, and thus lighter, cases will be produced in future when purer alloy steels become available as a result of the company's work.

INSPECTION.—All motor tube welds are subjected to X-ray inspection.

RURAL ROCKETRY.—Open country surrounds the Banwell factory, which was originally built during the War for Beaufighter production.

The Fighting Services

A.D.C. to Her Majesty

THE commanding officer of R.A.F. Changi, Singapore, Group Captain N. M. Maynard, D.F.C., A.F.C., has become an Aide-de-Camp to Her Majesty the Queen in succession to Gp. Capt. H. N. G. Wheeler, C.B.E., D.S.O., D.F.C., A.F.C., following the latter's promotion to Air Commodore.

Entering the R.A.F. College, Cranwell, in Oct., 1939, Gp. Capt. Maynard joined No. 228 Squadron as a pilot two years later, and in July of the following year was awarded the D.F.C. After holding posts as instructor at flying training and conversion units, he commanded No. 242 Squadron in 1949. In 1957 he was Senior Air Staff Officer, No. 25 Group, Flying Training Command.

Flight Safety Award

FOR his work in connection with airorew emergency procedures and the investigation of flying accidents involving injury, Sqn. Ldr. T. G. Dobie has been awarded the Richard Fox Linton Memorial Prize.

During 1960, while serving as Deputy Principal Medical Officer (Flying) at Headquarters, Flying Training Command, he visited the locations of all flying accidents involving casualties, and helped to shed light on many accidents the causes of which were obscure. Proposals for emergency drill in flight, largely formulated by him, have been accepted as a basis for reviewing current procedures. His Command's major accident rate in 1959 was the lowest ever recorded.

The Memorial Prize goes annually to the medical officer who performs the most outstanding work in the investigation of flying accidents and for the advancement of measures for the promotion of flight safety. It commemorates the death in 1953 on flying duties of Sqn. Ldr. Linton, a medical officer.

Washington Appointment

AIR COMMODORE R. H. E. EMSON, C.B., C.B.E., A.F.C., is to become Commander, R.A.F., and Air Attaché, British Defence Staffs, Washington, in March, with the acting rank of Air Vice-Marshal.

An armaments specialist since 1935, Air Cdre. Emson became Command Armament Officer, M.E.A.F., in 1951. Following this he was successively Deputy Director of Operational Requirements at the Air Ministry and Director of Air Armament (Research and Development) at the, then, Ministry of Supply before taking the 1960 course at the Imperial Defence College.

New Moscow Air Attaché

AIR COMMODORE M. D. LYNE, D.F.C., who was with the R.A.F.'s Merchant Service Fighter Unit which operated on the Wartime Arctic convoy run to Murmansk, has been appointed Air Attaché in Moscow.

Commanding Officer at R.A.F. Wildenrath in Germany since Apr., 1958, Air Cdre. Lyne commanded No. 54 Squadron at Odiham, Hants, in 1947, and has since served on the staffs of the R.A.F. College, Cranwell, the R.A.F. Flying College at Manby, and the R.A.F. Staff College, Bracknell.

Aircrew Recruiting Still Down

IN the course of a speech to the Preston branch of the R.A.F. Association on Jan. 31 the Secretary of State for Air, the Rt. Hon. Julian Amery, said that the Service looked forward with confidence to the challenge of an all-regular Air Force. Recruiting was going well, over all, and the R.A.F. fully expected to reach the manpower target of 135,000 officers and men by 1963.

"But," he continued, "there is one shadow on the horizon. We are not getting enough pilots and navigators of the high standard we need. It is only a question of a few hundred men, but unless they come forward the sharp end of the Service will become blunted."

Studying the situation, the Secretary of State said that he did not think the pay and conditions were at fault, or the insistence on very high standards. He believed, like so many senior officers, that the root of the trouble is the widespread belief that there is no future in flying.

"Nothing could be further from the truth. . . . Ten years from now the R.A.F. will need at least as many pilots and navigators as we have in service today. As far as I can judge the position will be much the same in 20 years from now. All this means that, provided he has the necessary qualifications, the R.A.F. continues to offer a life career to the man who wants to fly."

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. P. M. S. Hedgeland, O.B.E., to the Department of the Air Member for Supply and Organization.

Bomber Command: Wg. Cdr. R. S. Boast, O.B.E., D.F.C., to R.A.F. Hemswell to command, with acting rank of Gp. Capt.; Sqn. Ldr. S. D. Baldock, M.B.E., D.F.M., to R.A.F. Hemswell as Wg. Cdr. (Operations), with acting rank of Wg. Cdr.

Fighter Command: Sqn. Ldr. J. W. G. Smith, D.F.C., to Headquarters for duty with the Control and Reporting Examining Team, with acting rank of Wg. Cdr.

Flying Training Command: Gp. Capt. A. K. Catward, D.S.O., D.F.C., to Headquarters, Air Cadets, White Waltham, as Gp. Capt. Air Training Corps; Gp. Capt. D. L. Pitt, D.S.O., D.F.C., A.F.C., to R.A.F. Thorney Island to command.

Technical Training Command: Gp. Capt. L. T. Bryant-Fenn, D.F.C., to R.A.F. Bridgnorth to command.

Maintenance Command: Gp. Capt. D. Peveler, D.S.O., D.F.C., to the R.A.F. Staff College, Andover, as Assistant Commandant; Wg. Cdr. B. C. A. Fox to Headquarters, No. 40 Group, for equipment duties.

R.A.F. Germany: Wg. Cdr. F. Bowen-Easley to R.A.F. Bruggen to command the Flying Wing; Wg. Cdr. I. H. Cosby, D.F.C., to R.A.F. Geilenkirchen to command the Administrative Wing; Wg. Cdr. W. S. O. Randle, O.B.E., A.F.C., D.F.M., to Headquarters for Administrative Planning duties; Wg. Cdr. D. C. Furse, D.F.C., to R.A.F. Ueden for operations duties.

Middle East Air Force: Sqn. Ldr. G. Wynn to R.A.F. Pergamos, Cyprus, to command, with acting rank of Wg. Cdr.

Far East Air Force: Gp. Capt. R. D. Williams, O.B.E., to R.A.F. Seletar to command.

British Forces Arabian Peninsula: Sqn. Ldr. C. C. Povey, D.F.C., to Headquarters for operations duties, with acting rank of Wg. Cdr.

More Service News

Royal Tournament.—A demonstration of life-saving techniques in sea and mountain rescue, five massed bands and a physical training display will be the R.A.F.'s principal contributions to this year's Royal Tournament to be staged at Earls Court between May 31 and Jne. 17. Operation "May-Day" will demonstrate the complete sequence of events from the aircraft's distress signal to A.T.C. to the recovery of the aircrew.

Anniversary Concert.—The sixth annual R.A.F. Anniversary Concert will be held at the Royal Festival Hall on Apr. 26. As in previous years the concert will be given by the Hallé Orchestra under the direction of Sir John Barbirolli, and the Central Band of the R.A.F. under Wg. Cdr. J. L. Wallace, Organizing Director of Music.

INDIAN HUNTERS.—The final deliveries of Hawker Hunters to the Indian Air Force were recently accepted by the Indian Air Adviser, Gp. Capt. Moolgavka, at Dunsfold. Here he is seen with (left to right) Mr. J. R. Cotton, Mr. D. Simpson, Flt. Lt. R. G. Hanna, Transport Command ferry pilot, Mr. Anderson, Mr. A. W. Bedford, Mr. F. Murphy and Flg. Off. T. Kingsley, another ferry pilot.

Nuclear Power Possibilities

PROSPECTS of nuclear-powered flight were discussed on Feb. 2 by Mr. A. D. Baxter, M.Eng., M.I.Mech.E., F.R.Ae.S., executive director (engineering) of the de Havilland Engine Co., Ltd., in a main Royal Aeronautical Society lecture to the R.Ae.S. Swindon branch.

In his talk he surveyed alternative nuclear engine systems, indicating their layouts and approximate sizes and the problems they raised. His lecture, he said, was mainly theoretical and conjectural, because little information had been released on progress towards successful nuclear-powered flight; some of the points made are given below.

In all engines input energy is converted to an output of work. In aero-engines the initial energy is supplied as a chemical fuel; this is converted to heat energy in a combustion chamber and thence to shaft or jet power. The use of nuclear fuel only modifies this in that its energy is converted to heat in a reactor which acts as an alternative to the combustion chamber for a gas turbine engine. Similar arrangements would apply in principle to both ramjets and rockets.

Using a reactor as a heat source involves the transfer of heat to the engine working fluid. In conventional reactors the heat is removed by circulating either a liquid or a gas over the fuel elements and then through a heat exchanger. Liquids are, at first sight, more attractive because their greater density and better thermal conductivity permit smaller flow passages and more compact design. Water has been used quite extensively but, because it boils at relatively low temperatures even under pressure (e.g. 285° C. at 1,000 p.s.i.), it is no use in gas turbines where temperatures must be very much higher for efficient operation. Liquid salts and metals are much better in this respect. Mixtures of sodium and potassium, for instance, have a liquid temperature range from slightly above atmospheric to about 825° C.

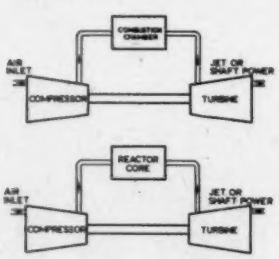
The use of gas avoids any temperature limitation due to change of state, but poorer physical characteristics involve larger heat transfer surfaces, greater temperature and pressure differentials and more severe leakage problems. In this country, experience has been mainly with gas-cooled reactors and steady progress is being made towards higher operating temperatures.

But gas turbines operate with atmospheric air as their working fluid and the use of other gases will involve some form of closed circuit for the reactor, as shown in the diagrams. The alternative is an open-cycle layout in which air is heated directly in the reactor. Both cycles have advantages and work in the U.S.A. is proceeding with both types.

The open cycle is less complicated, but under high-altitude conditions the low-density air cannot pick up sufficient heat unless the reactor core and cooling passages are large. These result in a larger overall reactor and an increase in shielding weight which may be critical. The indirect system permits a compact reactor, because the cooling gas is at high density, but it requires a circulator for the gas and a heat exchanger.

At flight speeds of Mach 2.2, the conventional turbojet has an overall efficiency of nearly 40%, but the nuclear turbojet efficiency will be only 30%, because of the internal pressure losses. This is not of prime importance from the fuel consumption point of view, but it does increase the heat to be removed from the reactor. For example, a thrust of 50,000 lb. requires 490 megawatts of heat. In this country Calder Hall produces 200 megawatts of heat per reactor.

Conventional reactor designs will give thermal outputs of about 10 megawatts per cu. ft. of core, but outputs of 30 megawatts per cu. ft. have been suggested and 50 megawatts per cu. ft. or more does not seem out of the question with some ingenuity in design. Thus outputs of 500 megawatts could be obtained from a core of, say, 2½ ft. diameter by 2½ ft. long, at a rating of 40 megawatts per cu. ft. This would require an investment of 20 kg. of U^{235} and the moderator/fuel ratio would be about 200 : 1.



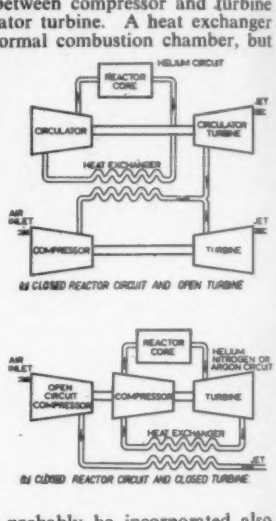
Diagrammatic comparison of the chemically fuelled gas turbine, top, and an open-cycle nuclear gas-turbine.

Fuel elements formed of long rods sealed in metal "cans" are inadequate for the large output, high temperature and high heat transfer rate required. One alternative might be to form the core of many small spheres of beryllia with the fissile material sealed inside. The beryllia would act both as moderator and "can" and give a much more robust arrangement within the volume limitations. It would also be much safer in case of a crash. Break-up of the pressure vessel of a closed-cycle powerplant would allow these pebbles to scatter and each would retain its own fission products.

The total weight of the core will be about 1,000 lb., but this is surrounded by a beryllium neutron reflector which adds almost 3,000 lb. Although not strictly necessary this is justified by economies in fuel investment and shield weight. Outside it is a pressure vessel and the radiation shielding.

For an open-cycle engine, instead of helium at 300 p.s.i. removing heat from the core, there is air at about 100 p.s.i., and hence the transfer surface must be greater. Thus the core will be larger, possibly 3 ft. diameter by 5 ft. long, and correspondingly heavier.

Main propulsion engines are basically the same as any conventional turbojets suitable for the same performance, except for the higher pressure drop between compressor and turbine and the air bleed to the circulator turbine. A heat exchanger would take the place of the normal combustion chamber, but



Two types of closed-cycle nuclear gas-turbine.

a combustion chamber would probably be incorporated also, so that thrust was still available with the reactor inoperative.

Calculations based on scaling the de Havilland Gyron Senior turbojet indicate that an engine with an overall length of 168 in. and an overall diameter of 56½ in. could produce a sea-level static thrust of 26,000 lb. for an all-up weight, including heat exchanger, of 10,250 lb. This thrust requires an energy input of 150 megawatts. The open-cycle engine is lighter and, because it can take full advantage of the reactor temperature, has a better specific thrust.

If the lift/drag ratio for a supersonic aircraft is assumed to be 6 : 1, then the nuclear powerplant overall weight/thrust ratio must not exceed 3.45 : 1. This is easily obtainable, but only at a high thrust level, because there is considerable powerplant weight which is independent of thrust. The limiting value occurs at nearly 50,000 lb. thrust and this means a minimum aircraft weight of 300,000 lb.

The operational advantage of the nuclear aircraft is its endurance. This has been assumed to be infinite but, in fact, there are several limitations. The first is a nuclear one, and usually occurs when something like 10% of the uranium fuel has been fissioned. Fuel elements must then be removed and reprocessed to abstract spent material. The fuel is used at almost 1 lb. for each 450 megawatt days of power. For a reactor containing 20 kg. of fissile material, this point is reached in about 3½ days at Mach 2.2 or 9½ days at M=0.9.

It is usually assumed that the very small fuel consumption of a nuclear-powered aircraft is equivalent to an equally small, and almost negligible, operating cost. This is not so, as uranium is expensive. It has been quoted in U.S.A. at £2,700 per lb. and, as mentioned earlier, a sortie may use 4½ lb. With these figures, the cost of nuclear energy delivered to the engine is about 0.12d. per h.p. hr. With kerosene at 1s. 2d. per gallon the cost of chemical energy is just about double.

British Executive Operators

1 J. C. Bamford (Excavators) Ltd.

Mr. J. C. Bamford.

LONDON Airport, to use its familiar rather than official name, is not, one would imagine, the best place to seek out the newest recruit to the expanding ranks of British companies whose executives have taken corporate wings. For one thing, L.A.P. eschews the lucrative pickings to be gained from opening its sanctified and uniquely expensive portals to private aeroplanes, executive or otherwise. In addition, one might not expect to find the proud owner of a brand-new business aircraft continuing so soon to patronize those scheduled services which his latest acquisition is designed to supplement, if not to replace.

For so busy and successful an executive as Mr. J. C. Bamford, whose company's activities in the field of excavation machinery have gained it a leading place in Europe during the past few years, intercepting his return from one business trip before he went off on another was the only guaranteed method of finding time to discuss his choice of the first D.H. Dove 8 to enter corporate operations. The aircraft itself was off on an extensive European trip, earning its keep, while Mr. Bamford returned from Switzerland by B.E.A., having made his personal contribution to consolidating still further the vigorous export drive achieved by his company.

The very name of his Dove—"Exporter"—is the key to its use, which is not to save money for the company, but to make it. In fact the Dove, in his opinion, is the only tool to provide the means of further expansion into the European export market; without its own aircraft, J. C. Bamford (Excavators), Ltd., would be unable to take its Continental sales campaign any further.

The initials "JCB" on hydraulic excavators are familiar enough already, and one had only to look out of the window at L.A.P. to see one of these remarkable miniature mechanical shovels showing an unparalleled degree of productivity for its size. But British exports face an increasing challenge in the European Common Market, and aggressive salesmanship is needed to avoid being at Sixes and Sevens.

You will find JCB excavators digging a hole outside the Colosseum in Rome, clearing the streets of snow in Copenhagen, or anywhere in the spread of Europe between Athens and Gibraltar, Brindisi and Helsinki. You may also find them still farther afield, but it is the European area for which executive air travel is the most fruitful. The major cities and capitals of Europe are well served by scheduled air services, but there is often difficulty in getting seats at short notice on the required service; the times are frequently inconvenient for business schedules; and much time is wasted in the tiresome formalities of mass air travel.

Mr. Bamford has now been making excavators for more than seven years, and it became apparent to him some three years ago that his business needed its own aeroplane. He was fortunate in the fact that he had been a qualified pilot, having learnt to fly at Derby in 1948, and for a short time had traded in light aircraft in a small way. He had also used charter services to bring dealers to his factory at Rocester, Staffs, although he found great difficulty in getting hold of such aircraft at short notice.

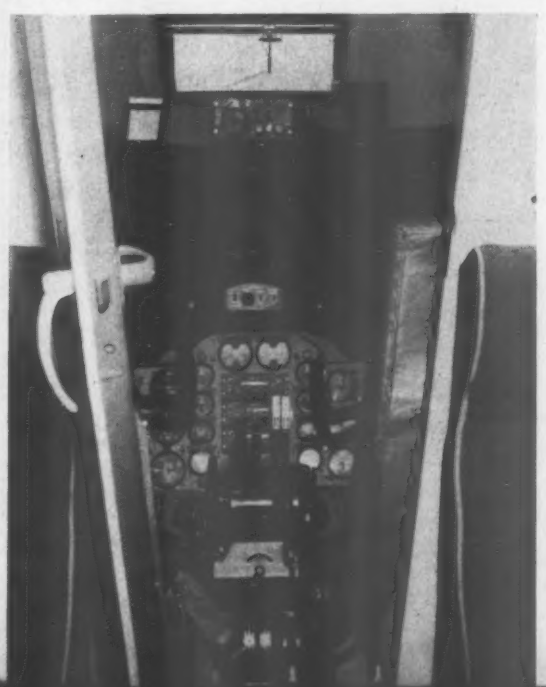
With his aviation background, however, he had a very clear idea of what he wanted from an executive aeroplane, which was primarily required for communications on sales and servicing. At least six seats were specified in a twin-engined type for airline-category operation, and a range capability for the European area long enough for the inclusion of a toilet compartment to be almost essential. This last is a practical point which has tended to be overlooked in types which have otherwise been given remarkable range characteristics.

Having decided in April, 1960, that his company was in a position to afford any of the available executive aircraft in this category, Mr. Bamford made a thorough survey in which he visited most of the leading American producers of these machines. With JCB Sales Director John Skeldon, he inspected an imposing array of types ranging from the £300,000 turbo-prop Grumman Gulfstream, which because of its size and performance is restricted to some 1,500 of America's 6,000 airports, to the light twins of Piper and Cessna at the other, and for his purpose, excessively small extreme of the scale.

The Beech twins, and particularly the Queen Air, were of considerable interest, but only the veteran Model G18S Super 18 combined the requirements of toilet and seat capacity. The lavishly equipped Twin Beech of company president Mrs. Olive Beech was loaned to Mr. Bamford for a couple of days and proved impressive, although its 23-year-old design and tail-wheel undercarriage showed in a less favourable light against its more modern competitors.

After examining the specifications of several other comparable aircraft, the Bamford team called in at Hatfield to see the Dove, which while comparing fairly closely with the Twin Beech in general performance, price and capacity, was a more modern design with a tricycle undercarriage and all the advantages of U.K. servicing and manufacturer's facilities. The new Dove 8 has the uprated D.H. Gipsy Queen 70 Mk. 3 engines developing 400 b.h.p. each for take-off, and has been especially developed, after more than 500 of the earlier series had been sold, for executive-type operation.

With a basic price of about £36,000, this proved to be the choice of Mr. Bamford, who requested the most comprehensive



Complementary means of executive transport are seen below by J. C. Bamford's Dove 8, with its new oil coolers, alongside a Rolls-Royce at Hatfield. A JCB excavator is in the foreground. Left, the well-appointed cockpit of the Dove, with Decca flight log above the screen.

selection of radio and navigational aids to be installed, bringing the equipped price to something like £55,000 or more. Most of the nav. and comm. radio is American Collins equipment, and the Bamford Dove, G-ARJB, also has the latest ATR Mk. 8 Decca, which is considered invaluable.

Also installed is the standard Elliott ESB-31 Interphone System, with two station boxes. Manufactured by the Airborne Radio and Radar Division of Elliott Brothers (London), Ltd., the station boxes enable the pilot to switch to any one or more of seven radio receivers, to switch his microphone to any of the four transmitters, and to speak to the co-pilot through an interphone amplifier in the station box.

Although G-ARJB is perhaps unusually well equipped, this is in keeping with one of the Bamford company mottoes, which is "the best is only just good enough." It applies this to its products as well as to its purchases, but as Mr. Bamford regards the Dove as essential to his business as a motorcar or any other form of transport, he is not particularly interested in what it costs. It is a management tool which his company cannot afford to be without—it is as simple as that. In any case, he considers that in its first week or so of operation, from Jan. 1 this year, in which it flew over 4,000 miles on company business, the Dove will have proved to have almost paid for itself.

Immediate Action

Capt. Michael P. Sutton, the Bamford company pilot, has reported on this outstanding example of the usefulness of a private executive aircraft, which was the inaugural business flight of "Exporter."

On a Saturday morning (Dec. 31) an urgent telephone call came in from Naples. An early model of the Bamford excavating machine, after six months' intensive operation, had shown up a serious defect. Six machines were to be dispatched on the Monday. The customer was "hedging" about taking delivery. By the end of the week over 30 more machines would have left the factory for distributors all over Europe.

Here then, the stage was set; a £13,000 order in the balance, the integrity of the machine in doubt and a further £75,000 worth of machines to roll out of the factory within the next seven days.

Only personal contact could possibly put this right. Departure from Birmingham was made at 5.15 p.m. on the Saturday evening, the aircraft refuelled at Nice and landed at Naples at 2.15 a.m. local time on the Sunday morning. At 9 a.m. the sales team were in the customer's office and by lunchtime the same day the situation had changed dramatically. The defective machine had been examined by experts from the factory, photographed, and remedial action cabled back to England advising the necessary modifications which were put into force at the start of work in England on Monday morning.

After calls at Rome and Lyon for further business on the return, the JCB team were back home on the Tuesday evening with, instead of a refusal on the six machines, an order for £375,000 worth of machines for the next year!

Obviously, such operations as these are impossible unless the aircraft chosen is capable of operating with airline regularity or better. It was for this reason, therefore, that no expense was spared in the equipment of this particular Mk. 8 Dove.

Double-capacity T.K.S. de-icer tanks were fitted and a special under-floor rear fuel tank designed and manufactured by de Havillands. Its installation did not reduce the capacity of the rear luggage locker, access to which is from within the toilet compartment in addition to the usual exterior hatch. This special tank has a capacity of 41½ imp. gal. or an additional 1¼ hr. duration over the standard system.

Duplicated Collins VHF is fitted with a Collins VOR/ILS/MKR receiver. Marconi AD 722 ADF is fitted within the raised Mk. 8 canopy, and a Sperry A.L.30 auto-pilot with height lock is provided. Where, because operations have to be made in and out of small ill-equipped landing fields in Europe, regularity, in spite of weather could not otherwise be achieved, despite the ILS/VOR set-up, a Decca flight log Mk. 8 is fitted also. Again this fits snugly in the "Heron" canopy.

Although operating single-handed on European airways day and night in all weather is considered sometimes a bit of a handful, experience has shown, Capt. Sutton considers, that this combination of navigational equipment, plus the Sperry auto-pilot and height lock, is the equivalent of another crew member, and operations to date have been 100% to schedule. This last point is an important one, for one crew member more in a Dove represents 15% less payload.

As an example of the type of operation it has made possible, Mr. Bamford quotes a recent two-day trip in which a JCB representative was able to visit Paris, Geneva, Lausanne, Geneva again, Düsseldorf, Brussels and Rotterdam. Five countries were also visited in five days, for only 8¼ hr. flying, and some 44¼ hr. could be spent with boards of directors—more than eight working hours per day, after travel. This sort of thing is only possible with a private aeroplane, which is a tremendous aid to productivity. A further gain, which was not anticipated, was the advantage of being able to take business conferences to their full conclusions, with no worries about catching airline services to a prearranged programme.

No precise utilization is planned for the Bamford Dove, although a figure of about 400 hr. per annum is anticipated, but the aircraft is used entirely on a demand basis. At this utilization, an hourly flying cost of about £40 is expected, which is a good deal more expensive than airline passenger flying, but it has been shown that costs comparisons are not valid. It is significant that a company with a personnel strength of only 350 is able to support its own aircraft, since excavator production is at the very high rate of some 120 per month.

Bamford pilot Capt. Mike Sutton was a further acquisition from de Havillands, having been a test pilot at Chester before moving to the design staff at Hatfield. The airfield of Taten Hill, near Burton-on-Trent, is to be shared by G-ARJB with the two Ind Coope executive Doves, which will also have a common servicing staff of licensed engineers. The airfield, which is currently being resurfaced, is only 10 minutes away from Mr. Bamford's home, with a further saving of valuable time.

From the company point of view, the airfield situation in England is lamentable, despite the fact that its dealers, who are the main consideration in the U.K., are seldom farther than about 25 minutes away from a landing field. This is one of the advantages resulting from the Dove's good short-field performance, which helps to offset such unhelpful decisions, quoted by Mr. Bamford, as the closing of Meir Airfield, Stoke-on-Trent, for use as a building site.

So important is executive time considered by this expanding young company, that Mr. Bamford is already looking towards the Dove's successor—the twin-jet D.H. 125—to keep pace with the planned growth in excavator sales. Resembling a scaled-down Trident, with all the jet experience of the Comet built into it, the D.H. 125 should have a similar airfield performance to the Dove for a comparable 1,500-mile range (G-ARJB having the optional long-range tanks), but with a cruising speed nearer 500 than the present 200 m.p.h.

When the D.H. 125 arrives, Mr. Bamford will probably keep the Dove for U.K. flights, with the jet machine for European routes. Looking further ahead, he wants a small supersonic executive type, so that he will not have to fly in jet airliners on scheduled services over his longer routes outside Europe.

This will be a far cry from the current Dove stage lengths of some 600 st. miles, with reserves, when carrying six passengers and baggage at up to 210 m.p.h., or up to 1,100 st. miles, with reserves, with a reduced payload. But the same vision that has enabled the enterprise of one man to build up in a short space of time his company's enviable position as the leading suppliers of earth-moving machines in Europe, will inevitably necessitate production of infinitely more advanced executive types, eventually with VTOL capacity.—JOHN FRICKER.

REPRESENTATIVE OPERATING COSTS, D.H. DOVE 8

ANNUAL UTILIZATION	500 hr.	600 hr.	750 hr.	900 hr.	1,000 hr.
FIXED ANNUAL COSTS	Cost in Pounds per flying hour				
Depreciation: Aircraft and spares depreciated over 8 years down to a residual value of 20%	9.50	7.91	6.33	5.28	4.75
Insurance: Annual premium 4% of aircraft first cost	3.60	3.00	2.40	2.00	1.80
Hangarage: Based on a rental of £10 per week	1.04	0.83	0.69	0.56	0.52
Crew: Assuming salary to be £2,500 per annum	5.00	4.17	3.33	2.78	2.50
HOURLY COSTS					
Maintenance and Overhaul: Airframe	2.16	2.16	2.16	2.16	2.16
Engines, using D.H. exchange price of £1,300 per engine and an overhaul life of 1,000 hours. (10% added for intervening maintenance.)	2.86	2.86	2.86	2.86	2.86
Propellers, using D.H. exchange price of £370 per propeller and an overhaul life of 1,200 hours. (10% added for intervening maintenance.)	0.68	0.68	0.68	0.68	0.68
Fuel and Oil: Fuel consumption of 31.1 gallons per hour and average fuel price of 3s. 9d. per gallon. 4% added for oil	6.06	6.06	6.06	6.06	6.06
Landing Charges: Based on Ministry of Aviation charge of £2 14s. 0d. per landing	1.61	1.61	1.61	1.61	1.61
Total operating cost per aircraft flying hour	32.35	29.28	26.12	23.99	22.94
Cost per aircraft mile—shillings	4.35	3.93	3.50	3.21	3.07
Cost per seat mile (6 seats)—pence	8.70	7.86	7.00	6.42	6.14

Note. The above figures assume a stage length of 250 miles, which by experience has proved to be a typical stage for the private user.

Project Surveyor

AN unmanned vehicle, capable of landing gently on the Moon and sampling fragments of the lunar surface, passed from the planning to the development stage on Jan. 19 when NASA selected the Hughes Aircraft Company to develop the Surveyor spacecraft. Hughes—now emerging as one of America's foremost satellite and space-vehicle specialists—was one of four companies which prepared design studies in a final competition. The company has recently put up interesting proposals for a lightweight communication satellite for use in a synchronous 24-hr. equatorial orbit (THE AEROPLANE AND ASTRONAUTICS, Jan. 13, 1961, pp. 44-46).

Technical direction for the Surveyor project, which is expected to cost more than $50 million, will be provided by the Jet Propulsion Laboratory of the California Institute of Technology. It is proposed to launch seven vehicles from Cape Canaveral between 1963 and 1966, using the Centaur as a booster.

The vehicle is intended to land on three shock-absorbing legs which, during take-off in the nose of the booster, would be folded back along the sides of the probe. Touch down on the Moon is to be made by means of a spherical solid-propellent rocket motor designed to reduce the landing speed to approximately 10 m.p.h. This is stated to be slightly less than the impact velocity of a parachutist landing on Earth.

Basic configuration of the spacecraft is shown in the accompanying illustration. It will have a squat conical centrebody surmounted by a directional antenna and solar cell panel, each being erected automatically after the landing. A Doppler radio-altimeter system will probably be incorporated as a means of controlling the retro-rocket.

When it has been injected into the prescribed lunar trajectory, Surveyor will weigh approximately 2,500 lb. At rest on the Moon, after mid-course and terminal manœuvres ending in the firing of the retro-rocket, this will be reduced to about 750 lb., of which some 500 lb. will comprise communication equipment and structure, and instrumentation for temperature control. The last item will be required to protect the vehicle from wide temperature extremes which will occur during the transition from lunar day to lunar night.

The remaining 250 lb. will be made up of scientific instruments, including several TV cameras, a seismometer to record "Moon-quakes" or meteoritic impacts, a magnetometer to determine more precisely whether or not the Moon has a magnetic field, and instruments to measure the lunar gravity, radiation, and—if such exists—the local atmosphere.

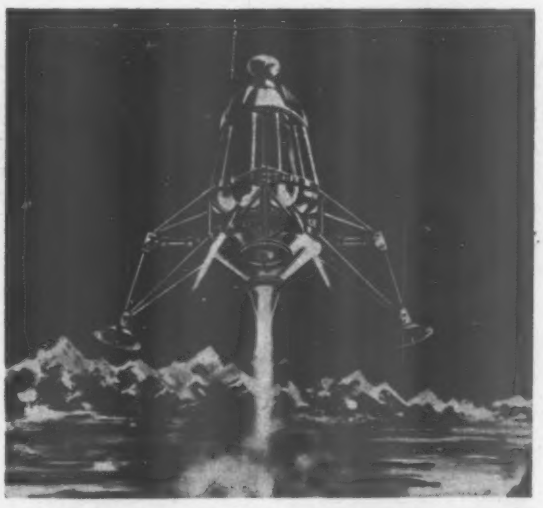
Most complex item aboard will be a rock-drill device which is designed to extend from the Surveyor vehicle automatically for the purpose of boring some 18 in. into the lunar crust. As it drills, small fragments of the surface material will be brought into the spacecraft where it is proposed to carry out a chemical analysis under remote control. J.P.L. scientists believe it may prove possible to use one of the TV cameras aboard the spacecraft to monitor this operation from the tracking station at Goldstone Lake, California.

To bring this experiment off successfully will not only require great ingenuity in the design of the operating mechanism and its associated electronics, but reliability will obviously be at a premium. In this context, it is of interest to recall that Hughes have been concerned in developing remote-handling equipment for use in nuclear radiation laboratories for some years.

A recent example is the Hughes Mobot Mk. II, which is equipped with two arms permitting 10 individual movements apiece; inflated pads serve as "hands" for performing delicate operations (such as pouring radioactive liquids from one flask to another), while TV cameras provide the remote operator in another room with a view of the proceedings.

Hughes have evolved similar techniques for conducting underwater explorations; some of their projected machines such as the Mobot Diver, can even be equipped with TV "eyes" to enable the remote operator in a surface ship to manipulate articulated arms for the purpose of carrying out repair and assembly tasks on the sea bottom. Experience with robot equipment of this kind undoubtedly has given Hughes a big advantage over other companies competing for the Surveyor contract.

An initial impression of the Surveyor spacecraft for which NASA are negotiating a contract with the Hughes Aircraft Company. Vehicle will stand 11 ft. high and weigh 750 lb. when at rest on the Moon. Seven are being ordered for launching by Centaur boosters in 1963-66.



This drawing by British astronautical artist John W. Wood shows an early configuration of the Migrant soft-landing spacecraft proposed by a B.I.S. study group in 1957-58. Thrust control of a retro-rocket employing storable propellents would be obtained by means of a radio-altimeter system.

A British Concept

Project Surveyor is reminiscent of the Migrant landing probe (Ref. 1) which was the subject of a British Interplanetary Society design study in 1957-58. The name was derived from the initial letters of Moon, Instrumented Guided Rocket and Notifying Transmitter. This 15-ft. vehicle was also envisaged as a vertical-landing spacecraft, embodying shock-absorbing legs and a retro-rocket. The design was based on British experience with small "throttleable" rocket motors employing storable propellents, and, in fact, had been put up as a possible space-payload which might be developed in this country for launching in a collaborative programme with the United States (Ref. 2).

A radio-altimeter was proposed as a means of triggering the retro-rocket and controlling the thrust.

Instrumentation was to include a magnetometer, radiation sensors, micro-meteorite detector, atmosphere sensors, and a seismometer. In conjunction with the last-named instrument, the probe was intended to eject "grenades" for the purpose of producing shock-waves in the lunar crust which, in conjunction with seismometers in probes landed at other points, might give some indication of the nature of the underlying strata by sensing the way in which the waves were reflected.

A directional antenna "dish" mounted on top of the spacecraft would signal the results to Earth; located on a dome beneath the antenna were to be four solar cell panels for energizing the electronics.

REFERENCES

1. Gatland, K. W., "The Robot Explorers," *Spaceflight*, Jly., 1960.
2. "Staff Report of the Select Committee on Astronautics and Space Exploration," U.S. Government Printing Office, Washington, D.C., 1958.

America's First "Chimponaut"

DESPITE the successful recovery of a chimpanzee in the Mercury MR-2 space-capsule launched on Jan. 31 from Cape Canaveral, there are bound to be certain misgivings concerning the "overshoot" which delivered the capsule some 130 miles farther on than was intended. To be sure, the test itself, involving separation from the Redstone booster and correct attitude stabilization, and re-entry at higher than planned speed, appears to have been an unqualified success. But one cannot pretend to be completely satisfied unless every part of the system functions flawlessly, especially when there are hopes of soon launching a human passenger.

One word—reliability—sums up the situation.

The original flight plan called for the capsule to reach a maximum altitude of about 115 miles and travel some 290 miles downrange. This would expose the animal occupant to a period of weightlessness lasting about 4½ minutes. In fact, the capsule reached a speed of some 5,000 m.p.h. (1,000 m.p.h. faster than planned), rose 155 miles and landed 420 miles from the Cape. As a result, the spacecraft was over three hours in the water before it was picked up.

The sequence of operations worked out for Mercury space capsule are set out hereafter.

After the booster thrust has terminated, the escape tower above the capsule jettisons. (If the rocket had gone off course or had suffered some other drastic fault after lift-off, the capsule would have separated by means of this escape tower and the capsule would have been recovered by parachute). However, if it is not operated, it is jettisoned to reduce the capsule's mass after the cut-off point. Next, the three small "posigrade" rockets on the blunt face of the capsule are fired to achieve separation from the booster.

Immediately separation has occurred, an autopilot comes into operation to correct any irregular motions of the capsule which might follow as the result of enforced separation. Some five seconds after separation, the autopilot will swing the craft around completely so that the heat-shield now faces forward. Near the peak of the trajectory, control jets will orient the blunt face up 35° above the horizontal plane.

Normally, as the capsule reaches apogee, this is the time that the three powerful retro-rockets attached to the heat shield will be fired in rapid succession. They may not always be operated in the Redstone tests but will be when Atlas is substituted later as part of the overall qualification programme. After the three have been fired, the retro-package will be jettisoned and the autopilot will orientate the capsule with the heat-shield in a downward attitude preparatory for re-entry.

Air friction will generate some heat build-up on the shield at roughly 45 to 50 miles altitude and the control system will begin correcting any capsule oscillations or pendulum motions which might begin during the re-entry phase. The control system also starts the capsule turning about its vertical axis in a slow, top-like, motion as a means of reducing landing-point dispersions. This, of course, is the most critical part of the descent.

The young chimpanzee, Ham, which was recovered alive and well after a sub-orbital test of the Mercury capsule on Jan. 31.

At approximately 21,000 ft., a pressure-sensitive switch deploys a 6-ft. drogue parachute which is to help curb the speed of the capsule which, at this point, is subsonic. Simultaneously, radar chaff is scattered to assist radar tracking.

Then, at 10,000 ft., the antenna canister on the small neck of the capsule is blown off to eject the 63-ft. main supporting canopy. An explosive SOFAR charge, set to explode 2,500 ft. under water, will also be released.

Twelve seconds after the main parachute has deployed, a timer releases a perforated landing impact bag, a 4-ft. skirt of plastic which joins the heat shield and the base of the capsule. The shield drops down, extending the skirt. The bag acts to soften the water impact and becomes a sea anchor once the capsule is in the water.

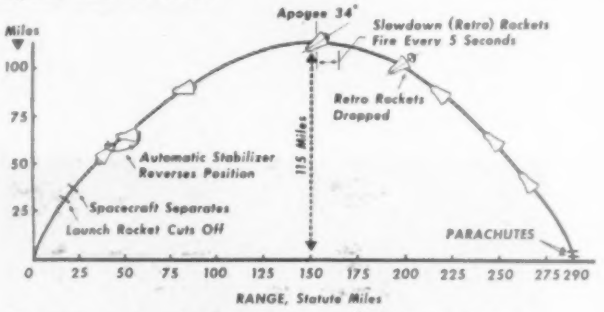
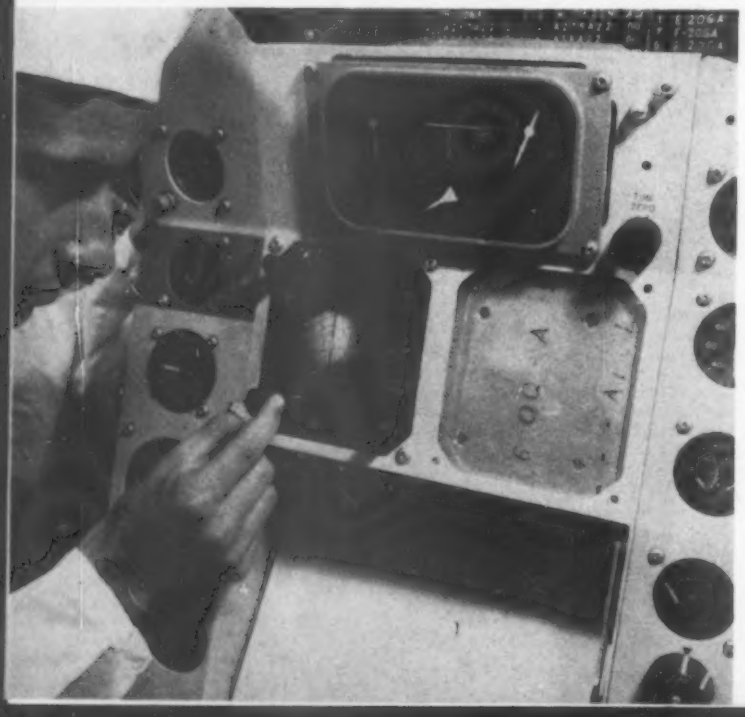


Diagram of the intended Mercury trajectory. In fact, the capsule travelled about 420 miles.

Upon alighting, a switch jettisons the parachute to avoid dragging the spacecraft in the wind and a high-intensity flashing light on the upper part of the capsule is activated. Sea-marking dye is ejected as an aid to recovery teams and a SARAH radio beacon starts sending signals.

The beryllium heat shield fitted for the chimpanzee flight differs from the ablative plastic shield to be used in later tests with Atlas, when the shield will be subjected to much higher temperatures of around 3,000° F. It was not expected that the Redstone tests would produce temperatures greater than 100° F., although this may indeed have been exceeded in the recent launching due to the higher final speed. Atlas tests are expected to achieve speeds of some 17,400 m.p.h.



STRICTLY FOR HUMANS.—Close-up of the Mercury instrument panel. The technician is adjusting a unique instrument called an Earthpath indicator. Developed by Minneapolis-Honeywell, this is a dead-reckoning computer part of which is a mechanically operated revolving globe which will continually indicate the astronaut's position in relation to the surface and where he will land after re-entry from orbit. Above it is another instrument called an attitude and rate indicator. This unit will gyroscopically sense the attitudes of the capsule and give the astronaut the roll-pitch-yaw visual information essential for visual control.

If the time has come . . .

If the time has come when a company-owned aircraft is a necessity, consider the experience of de Havilland. Except during the war they have always built executive aircraft. The lessons of four decades and more are embodied in the new Dove.

With increased power, improved performance, superior equipment entirely suitable for all-weather operation, the new Dove 8 is the best aircraft in its category. The same may be said of the larger four-engined Heron.

de Havilland built and de Havilland powered, with two Gipsy Queen 400 h.p. engines and de Havilland propellers, the Dove 8 executive carries up to six passengers and two crew on practical stages of about 600 miles (*960 km*), at 210 miles (*336 km*) an hour. Doves and Herons are flown and serviced the world over.

. . . consider the experience of DE HAVILLAND

The de Havilland Aircraft Co. Ltd., Hatfield, Herts. *Member Company of the Hawker Siddeley Group*

JCB LEADS THE WAY

with the purchase of the first De Havilland Mark 8 Dove

J. C. Bamford (Excavators) Ltd are Europe's largest manufacturers of hydraulic excavators, and export some 43% of their production. Increased competition and rapidly changing markets abroad have emphasised the need for a fast, efficient means of transport to facilitate movement of executives and spares at very short notice.

JCB leads the way - others will follow

JCB ROCESTER STAFFS (UTTOXETER 3122 TELEX 3654

Slow Progress at Strasbourg

WITH so many countries involved, only slow progress is to be expected in the efforts being made by Mr. Thorneycroft to form a European Space Club. An example of the setbacks to be expected, often, no doubt, as part of political bargaining, was the official German reaction to the proposals following the conclusion of the four-day conference in Strasbourg on Feb. 2. Three days after delegates had returned home, Herr Franz Josef Strauss, the West German Defence Minister, stated that although Germany agreed in principle to the idea of a space-programme, they were opposed to the use of Blue Streak. This, he said, would only mean spending millions more to duplicate pioneer work already done in America. He therefore advocated buying proved rockets from the United States.

Only a few days before in Strasbourg, Mr. Peter Thorneycroft, Minister of Aviation, had said that nothing had happened at the conference to dash his hopes for Blue Streak. Keen interest had been expressed by delegates in the political, economic and technological opportunities which would be offered by the joint project, though as it encroached on so many fields final decisions could only be taken in the respective capitals.

In addition to the main countries attending—listed in our report last week—observers attended from Canada, Greece, Eire and Turkey. Australia was also closely concerned because of the range at Woomera. France, which sponsored the conference in partnership with Britain, certainly seems as anxious as ourselves to see the project through. Their delegate, M. de Roze, stressed the economic importance of Europe working collectively in this and other fields, and clearly there are important issues surrounding the future relations of the Common Market countries and those of the Free Trade Area.

Much of the proceedings was held in closed session. Two committees were set up for the purpose of settling detail problems. One, with Mr. D. W. G. L. Haviland (M.o.A.) as chairman, considered finance and administration, while the other, chaired by Gen. Aubinière of the French Air Ministry, dealt with technical matters.

The overall project will involve an expenditure of some £70m. spread over five years. This would permit nine major launchings, with the prospect of having the first satellite in orbit in four to five years.

The financial statement is shown in the accompanying table. At first, Britain's contribution was announced as £17,500,000 but later, after the figures had been considered by the various delegates, it became clear that some considered their financial commitment would be too high in terms of the share their countries would have in the actual development.

This led to Britain raising her own contribution to £23,300,000. Mr. Thorneycroft explained the offer as something which would benefit Austria, Belgium, Denmark, the Netherlands, Norway, Spain, Sweden and Switzerland. From Britain's point of view, he said, if we went in we were in to stay, and because probably more than half the work was associated with the first stage of the launcher, it was only fair and proper that Britain should shoulder most of the financial load.

Thus, if the programme goes ahead, it is anticipated that some 55% of the £70m. total will be spent on modifying the Blue Streak as the first stage. Work on the proposed French second stage will account for a further 18% and the final stage another 9%.

It is expected that Australia would be offered free membership of the "Space Booster Club" in view of the facilities offered by the Woomera range, although, as yet, there has been no public mention of reorientating the launching corridor to permit polar orbits or launching to the N.E. (the present missile-testing corridor is angled to the N.W., against the direction of the Earth's rotation, which, apart from other considerations, would exact a payload penalty from satellite boosters). Nor has the question of providing additional ground stations, both in Australia and in other parts of the World, been mentioned in any detail.

The future of the project now awaits the conclusions of the smaller countries, and the reactions of the British and French Governments to the German refusal to accept Blue Streak. Perhaps the Germans' reaction would have been different if they could have been offered a greater share in the work. The country is being asked to contribute £12,789,000—the largest amount after Britain and France, but German industry would be restricted to a comparatively minor rôle in developing the launcher.

It is Mr. Thorneycroft's hope that all the countries concerned in the Strasbourg discussions will be able to indicate their decisions in principle before the end of March.

United Kingdom	£23,300,000 (£17,500,000)
France	£15,582,000
West Germany	£12,789,000
Italy	£7,427,000
Spain	£2,055,000
Sweden	£2,020,000 (£3,395,000)
Belgium	£1,986,000 (£3,423,000)
Netherlands	£1,843,000 (£2,646,000)
Switzerland	£1,576,000 (£2,346,000)
Denmark	£953,000 (£1,561,000)
Austria	£924,000
Norway	£770,000 (£1,204,000)

Provisional scale of contributions for countries joining Britain and France in the proposed European Satellite Launching Organization. Figures in parentheses indicate original estimates.

Cheap ICBMs for the 'Sixties

THE era of the relatively cheap and simple "push-button" ICBM is approaching fast; this was clearly shown on Feb. 1 when the first Minuteman was test-launched from Cape Canaveral. On its very first free launch all three stages of this solid-propellent missile were fired and it travelled some 4,600 miles down the Atlantic Missile Range to land "well within the target area."

Early launches are being made from a flat pad; later ones will be from a concrete silo. The first launch was originally scheduled for last December.

The Minuteman flight contrasts with the test technique used for the larger and much more complicated liquid-propellent missiles such as Atlas and Titan. Their testing began with very much shorter flights using only partial propulsion, and the range was built up very gradually. The U.S. has learnt a great deal about missile development since then. This experience, coupled with the greater simplicity of the solid-propellent missile, has led to much more effective programme planning and advance testing of missile components and systems.

As a result, development times have been reduced; the Minuteman programme was put on a crash basis in February, 1958, and the missile will come into service by the middle of 1962, a year ahead of the original schedule. Six hundred will be deployed by the end of 1964. Of these, 450 will be deployed in fixed silo sites in remote areas.

Each squadron will have 50 missiles with five spares. Each missile will be in an underground concrete silo on a two-acre site and its firing will be remotely controlled. Missiles will be kept in their silos for up to three years before removal for major overhaul. Sites will be far enough apart to prevent more than one being eliminated by a single nuclear warhead. The first three squadrons will be near Malmstrom Air Force Base in Montana.

Reaction time of these silo missiles will be very short; they do not need to be fuelled before firing. They will give the U.S. almost a "push-button capability" for retaliation if attacked.

In addition, 150 Minutemen will be mounted on special railway trains which will move over the U.S. rail network to prevent their position being pinpointed. Each train will carry five missiles.

As a sophisticated second-generation ICBM, Minuteman has a much smaller nuclear warhead than Atlas and Titan, which are regarded more as the "heavy artillery" of the nuclear deterrent. Minuteman weighs about 70,000 lb., compared with 260,000 lb. for Atlas.

With a lower-yield nuclear warhead and extreme accuracy, Minuteman is well suited for the counter-force policy of the U.S.A.F., which aims to hit back at an enemy's military power rather than at its cities and population. Each Minuteman will cost only between one-quarter and one-fifth as much as an Atlas ICBM.

This new ICBM will be deployed in much greater quantities than Atlas or Titan. Missile for missile, Minuteman represents a big advance; it will be cheaper, more accurate, less vulnerable and much quicker to launch.

This simplicity and relative cheapness is probably the greatest achievement of the U.S.A.F. missile programme. Minuteman may not offer "more bang per buck," but it certainly gives "more deterrence per buck." No visitor to Cape Canaveral can fail to be astounded at the stark simplicity of a Minuteman launch complex when compared with the vast and complicated launch pads and control bunkers needed by Atlas and Titan. The U.S.A.F. deserves great credit for reversing the trend towards ever more complicated and costly missile systems.

Flying the Rover-turbined Wot

by John Fricker

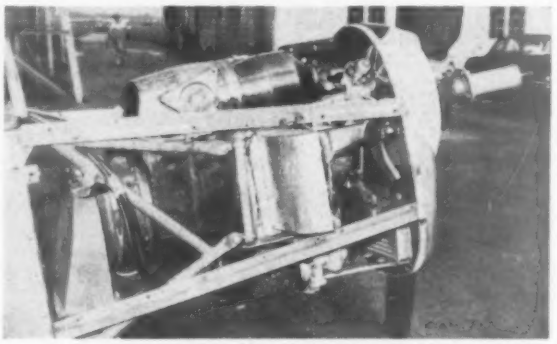
LAST week I strapped myself in the single open cockpit of a tiny biplane at Eastleigh, Southampton, turned a key on the simple instrument panel, and listened to the characteristic "jet" wail resulting from the spinning-up of a compressor under the long cowling ahead of me. A background ticking of high-energy ignition was followed by a "woomph" as the turbine unit lit at 5-6,000 r.p.m., and rapidly accelerated to indicate about 20,000 r.p.m. on the tiny tachometer in the centre of the dashboard.

The oil pressure warning light went out, and I carefully pushed open the big throttle lever on the left-hand side of the cockpit. After a few seconds delay, the revs. smoothly rose to about 30,000, and the little Currie Wot—virtually a miniature Tiger Moth, and flying test-bed for the Rover TP/60/1 light gas-turbine—moved briskly off over the ruts and puddles of Eastleigh's sodden turf.

With no further checks or actions, I turned into wind and slowly pushed the throttle to the far end of its travel. Some seven seconds later the Rover turbine wound up to 49,000 r.p.m. on the tachometer, and with a smooth back-pressing surge of exhilarating thrust, the little Wot was pulled off the ground in a few yards and sent hurtling skywards. All the characteristic vibration-free qualities and quiet power of the turboprop were immediately apparent, and I had to remind myself that I was flying an ultra-light aeroplane of pre-War design.

Thus was my introduction to the age of light aeroplane turboprop power. Except for the care needed when opening the throttle at low r.p.m. to avoid compressor stall, and the slow power response, engine handling was completely uncritical. The brief and most stimulating flight convinced me that whatever practical difficulties remain to be solved, and they are by no means inconsiderable, turboprop light aircraft are both feasible and desirable.

This, of course, has already been proven elsewhere, particularly in France by Turboméca, and in the United States by Boeing, Solar and others. These developments, however, have been generally in rather larger power brackets and with considerably more sophisticated (and correspondingly expensive) equipment.



Photographs copyright "The Aeroplane and Astronautics"

Uncowled, the Rover TP/60 turboprop unit shows its compact layout, single combustion chamber, lateral intake and downward-deflected jet pipe. Also visible is the oil cooler radiator.

The utmost simplicity characterizes the Wot test-bed cockpit. On the engine control panel are ignition key, ammeter oil pressure warning light, tachometer and JPT gauge.

Among the charms of the Rover approach are its simplicity and common sense, which have resulted in returns out of all proportion to the limited funds so far invested. Whether these small turboprops can be brought to full practicality with a continuing low-cost budget remains to be seen. The maintained enthusiasm, however, of Mr. Llewellyn of Rover Gas Turbines, Ltd., and Vivian Bellamy, C.F.I. of the Hampshire Aeroplane Club, which has been almost entirely responsible for getting a prototype turboprop powerplant airborne without snags for more than 30 hr. in the hands of many different pilots, promises well for the future.

All flying to date has been done in the little Wot, which is about the most uncomplicated, and therefore trouble-free airframe possible as a test-bed. It was selected, apart from its strength and docility of handling (vigorously demonstrated during last year's Lockheed Aerobatic Competition), as being powered with a piston-engine of a similar output and weight to the Rover TP/60/1, which replaced its 60 b.h.p. Walter Mikron early last year.

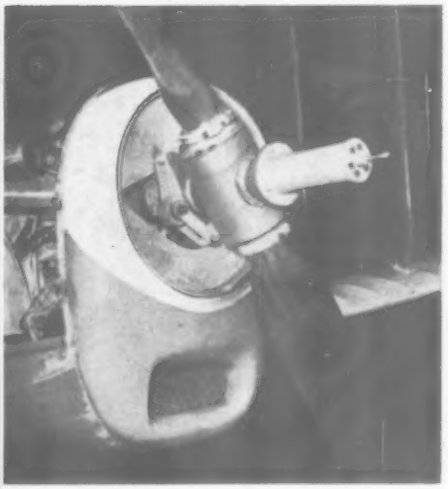
The Rover turboprop was then a simple adaptation of the 1S/60 industrial gas turbine, with a fixed-pitch Fairey-Reed metal airscrew bolted to its drive shaft. Naturally enough, with no pitch variation, the compressor unit would only unstall itself by the time the Wot was travelling practically flat out,

and even this had to be achieved by removing the temperature-control valve in the fuel system and discreetly ignoring the JPT gauge as its needle went almost off the clock.

Nevertheless, these brief flight experiments proved how good-tempered the basic industrial turbine was, and what its potentialities as an aircraft prime mover could be. They also confirmed that, as expected, pitch control was to be one of the biggest problems in any turboprop application.

Turbine-propeller units require a greater pitch range than piston powerplants, since the airscrew blades must be virtually at zero angle for starting for the compressor assembly to accelerate away without stalling. A high degree of automaticity in pitch operation is also essential for rapid variations of thrust with throttle movement, since the inertia of the rapidly spinning turbine precludes such alterations by small changes in engine speed.

For such small engines the complications of automatic pitch control on larger turboprops are neither possible nor desirable, but a very simple system presented itself in a flash of inspiration to Mr. Llewellyn for the TP/60. In brief, two wooden airscrew



The ingenious Rover automatic v-p airscrew on the turboprop Wot is seen here with its Moth-type wooden blades at minimum pitch of about ½°, for starting, with the balance weights in closest proximity to the hub. The engine drive-shaft flange, and its coarse pitch stop, are visible immediately behind the balance weight.

blades rotate in a metal hub, on Skefco thrust bearings and lower root journal bearings. On the end of the latter, on each blade, is a bevel gear which meshes with a bevel pinion keyed to the engine drive shaft.

The flange of the airscrew hub is connected to a flange on the engine drive shaft, on which it can rotate to a limited extent, by a torsion link on each side, with balance weights at their outer pivot points. Automatic pitch change is achieved during starting for example, when the prop. hub lags slightly behind the drive shaft, thereby expanding the torsion links, bringing in the balance weights and reducing pitch through the bevel pinion and gears on each blade. As engine speed increases, the weights fly out until equilibrium is achieved between torque loading and centrifugal force.

With an increase in aircraft speed comes a reduction in torque loading for that particular pitch setting. Because the load separating airscrew hub and engine drive flange is reduced, the torque links close, sending the weights farther out, and increasing pitch until equilibrium is once more restored. A bias towards fine pitch for a more effective response at lower speeds is provided by a torsion bar within the drive shaft and airscrew hub.

So much for the theory behind the Rover automatic v-p prop. From the pilot's point of view, which I was to explore myself, it could be regarded much as a constant-speed airscrew in that the power it absorbed remained the same at a given rotational speed, irrespective of airspeed or attitude of the aircraft. If you climb or reduce airspeed, the propeller fines off to maintain revs., while in a dive, the pitch coarsens up to a stop on the engine flange. There is no flight fine-pitch stop, and the blades are able to reach their minimum angle in the air, when the turbine is switched off, to windmill at 10,000 r.p.m., with no undue effects on handling or control.

With the excellent automatic start system, the Rover turbine in the Wot has been relit in the air many times during its recent trials, which have been up to about 6,000 ft. (Viv Bellamy's personal icing index) and no relighting problems are anticipated up to 20,000 ft. Designed for static conditions, the turbine unit itself may require some development to run at the current peak altitudes for light aircraft, if compressor stalling or surging are to be avoided.

Apart from the propeller installation, main modifications to the basic 1S/60 for aircraft use concerned the fuel system and reduction gearing. An air-assisted burner, with a tapping from the diffuser, gives better low-speed combustion with easier starting and improved throttle response. A couple of gear stages were added to bring the very high operating revs. of a small diameter turbine to a manageable level, through 14,500 and the normal commercial 3,600 r.p.m., finally to 2,440 r.p.m. for the airscrew drive. Extra gearing, instead of redesigning the main reduction gear, brought the installed weight of the TP/60/1, including 12-v. electric start system, generator, oil cooler, airscrew, spinner and control panel, up to about 250 lb., compared with the industrial unit's basic 130 lb.

As Rover did not plan to proceed with the 60 b.h.p. development engine, its weight is not regarded as unduly important. The same turbine, with slight modifications, is available industrially as a 90 b.h.p. unit, and as an aircraft powerplant this is to be made available as the TP/90/1, developing 120 b.h.p. for take-off. For about twice the power of the smaller engine, the TP/90 should weigh the same or less. Under development is an even bigger and twin shaft turbine, for marine or aircraft application, with a maximum output of 170 b.h.p., and a continuous rating of 150 b.h.p.

If Rovers can produce these bigger units with the same absence of black magic in their handling as the TP/60, which does not even have a fuel cock in the Wot, most of their marketing problems will be solved. A more positive response, however, to throttle movement than is currently available will be necessary. At the moment if the throttle is opened other than gingerly, the backfiring-type bangs of compressor stall accompany the gradual winding up of revs. The noise does not seem to be accompanied by disaster, but it might frighten the customers.

Apart from this peculiarity, the Rover handles well on the ground, and taxi-ing the Wot, despite its absence of brakes and its fixed tailskid, was quite simple with the help of airscrew slipstream, once you could anticipate how much power was required at a given time. A glance at the wire float indicator in front of the 1914-18-type flat windscreen confirmed that the 11½-gal. fuel tank was full of kerosene, for just on one hour's endurance, at the low altitude of my evaluation flight. At 3,000 ft., cruise consumption falls to about 8½ g.p.h.

The heavy fuel consumption at normal lightplane operating heights is a big disadvantage of the turboprop. While kerosene is as cheap as petrol for a given range, the larger volume which must be carried tends to push out the payload.

I found the Wot quite simple to keep straight at full power, despite the resulting surge of torque, and although the tachometer indication was way beyond the red line at 47,000 r.p.m., I was assured that neither revs. nor JPT (at around 650° C.) ever approached their limits. Certainly signs of strain were the last symptoms apparent in the splendid and vibrationless surge of power at full throttle. The refreshing absence of noise and bustle as the lever was brought back to about half-way for cruising at some 45,000 r.p.m., even in a draughty open biplane, promised well for more advanced applications.

With its built-in drag, the Wot cruises no faster, at 85 m.p.h., than it did with the Mikron, although take-off and climb are remarkably improved. Experiments with throttle movement in the air showed that a fairly large alteration was needed to get an appreciable change in revs., and even then thrust differences were slow to register as increases or decreases of speed. This was proved decisively when attempting to fly formation on a photographic aircraft, which proved quite impossible on initial acquaintance with the power response of the Rover unit.

Movement of the throttle alters the fuel flow to the engine, which has a spill-valve for the upper limit, linked to JPT via a mercury-boiler switch. Thus, while throttle movement seems to have little effect on thrust, it has a great deal on fuel consumption, and a flowmeter (removed just before our flights) would seem to be one of the best and simplest ways of providing some indication of power output. Revs. clearly are of

little use in this connection, and the best solution to the power response problem would probably be to keep r.p.m. fairly constant, and use the throttle to obtain almost direct control of pitch.

Something like this system is to be used on the definitive TP/90 engine, which in any case cannot make use of the current automatic v-p airscrew, and will have hydraulic pitch-change operation with separate throttle and pitch levers having some sort of interlock. One of the limitations on the present airscrew is that the balance weights have to be selected for a limited range of ambient temperatures, which alter the power output of the engine by a substantial amount.

Time did not permit a full exploration of the TP/60's characteristics, but it has been aerobatted in the Wot, and has a 15 sec. inversion limit for the oil supply. The fuel system is less happy at the moment under negative *g*, which results in a flame-out. In a loop, from 120 m.p.h. in the Wot, the revs increase by about 200 from 45,000 during the dive, and decrease by 100 or so in the climb.

From the general handling point of view, the airframe and engine made a delightful combination, the Wot being very light and responsive for so smooth a powerplant. With the Mikron this same aircraft was flick-rolled violently at Coventry, spun with vigour and generally wrung-out, so that it conveys to the full all the joys of open-cockpit flying.

For the low-speed handling of engine and aircraft, I contented myself with throttling back to about 30,000 r.p.m., and reducing speed to about 40 m.p.h. A.S.I., since to avoid local overheating possibilities round the tailpipe outlet beneath the fuselage, one is advised to switch off completely before trying the stall. Deceleration is fairly slow, but handling of airframe and turbine is unexceptionable, apart from the equally slow acceleration on opening the throttle. To avoid complications on the approach, I came in high, throttled right back to 25,000 r.p.m., and brought the Wot in a steep slip at about 60 m.p.h. for landing.

Being an old-fashioned aeroplane, it side-slipped very nicely, and although the airscrew should theoretically have been discing, there were no adverse effects on the elevator at all. The shallow tail-down attitude for a three-point landing was easily achieved, and behaviour throughout was entirely conventional. A second circuit confirmed the complete normality of Jet Wot operation, and this alone is a remarkable achievement.

ROVER TURBOPROPS

Type	TP/60/1	TP/90/1
Pressure ratio	2.95 : 1	2.8 : 1
Air mass flow at 46,000 r.p.m.	1.45 lb./sec.	1.88 lb./sec.
Installed weight	235 lb.	235 lb.
Max. T.O. power, 47,000 r.p.m.	70 b.h.p.	120 b.h.p.
Airscrew r.p.m.	2,440	2,525
Cruise power, 46,000 r.p.m.	60 b.h.p.	90 b.h.p.
Turbine disc	Nimonic 90	Nimonic 105
S.F.C. (lb./b.h.p./hr.)	1.36	1.38
Power/weight ratio	3.36 lb./b.h.p.	1.96 lb./b.h.p.

Single-shaft, single-stage, 17-vaned centrifugal compressor, one reverse-flow combustion chamber, single-stage axial-flow turbine. Height 27.5 in.; width 20 in.; length 30.1 in.

Rover are undoubtedly right in feeling that there is a large potential market for small gas-turbines in aircraft, although how far away this is could be anyone's guess. The Wot experiment will at least give them some idea of the possible response, for the TP/90 project. It is thought that the lag in throttle response can be fairly simply overcome with an hydraulically-operated airscrew, although apparently none of the big propeller companies have shown any interest in the problem. Rover have no intention of taking up airscrew design, but Hartzell, among the American companies, has shown considerable interest.

The fuel consumption problem remains, but against this is the tremendous potential saving in maintenance. In industrial use, the same turbines have run for 3,000 hr. and more with little or no skilled attention. Most of their wear has been confined to erosion of moving parts by polluted air. Aircraft should be less troubled by this problem, and possible overhaul periods of up to 5,000 hr. are foreseen eventually for small turboprops.

The principle of their lightplane application has now been proved, and the TP/90, with a different compressor section, bigger diffuser nozzle and turbine throat areas, and a higher permissible JPT for its Nimonic 105 turbine should have a wide potential appeal. Its anticipated price of £1,500-1,600, as a complete powerplant including propeller, compares reasonably well with equivalent piston-engines.

Gliding Notes

by Dr. A. E. Slater

IN his lecture to the Man-powered Aircraft Group at the Royal Aeronautical Society, Lorne Welch discussed the merits of muscle-power propulsion as an aid to sailplane performance on cross-country flights. He did not recommend it, because cross-country soaring needs all the pilot's attention, and the distraction of pedalling could more than offset any aerodynamic gain.

He also showed, with a diagram, that additional human power could only increase the average cross-country speed of a conventional sailplane from 20 to 24 kt., or from 30 to 33, or 40 to 42½. In fact, such a machine would need 2½ h.p. to keep it in level flight. He admitted, however, that very little detailed structural testing has been done on sailplanes so far, with the result that many components are heavier than they need be, and anyone prepared to go to a lot of trouble could easily reduce the total weight, thus giving muscle power a better chance.

* * *

ONE missing link in the story of the World's first man-carrying glider, designed by Sir George Cayley over 100 years ago, has just come to light, and that is the name of Sir George's coachman, who actually made the first flight in it, and immediately afterwards gave notice to his master, saying: "I was hired to drive, not to fly."

The two authors of "The Guinness Book of Records," Norris and Ross McWhirter, describe it correctly in the latest edition as "the earliest man-carrying glider," but they were worried at not being able to discover the pilot's name. Then, according to a gossip writer in the *Manchester Evening News*, it suddenly occurred to Norris McWhirter that all census records are kept; so he looked up the 1851 census for Scarborough, near the site of the historic event, and found that Sir George Cayley had then only one footman, John Appleby, aged 17, who was born in Peckering.

Even this does not seem absolutely conclusive, for the flight was made in either 1852 or 1853, which gave Sir George time to acquire another manservant. But if John Appleby was the aviator he must have been 18 or 19 at the time.

Even the shape of the glider was unknown to history until last year, when Charles Gibbs-Smith was looking through back numbers of the *Mechanics' Magazine* and to his surprise found drawings of it in the issue for Sept. 25, 1852. The wing was somewhat kite-shaped, with an aspect ratio of less than one, but in spite of this its total area, plus that of the tail, was about 500 sq. ft., or nearly three times the area of a typical sailplane. The pilot had no controls, but the wing had a dihedral angle of 8°, and the tail, though fixed during the flight, had previously been adjusted after trial flights with ballast.

Cayley's claim to fame as the "father of British aeronautics" rests chiefly on an article published in *Nicholson's Journal* in 1809. But although he enunciated the principle of the aeroplane, the article shows him to be apparently unaware that there was such a thing as soaring flight, for he twice explains the horizontal flight of birds on motionless wings as due to the momentum built up by a previous burst of flapping. He died in 1857; but if he had lived long enough to develop his glider further, he might have launched it off a hill-top into wind. If it soared, he should have been clever enough to explain why. It was not till 1883 that Lord Rayleigh gave the first simple explanation of soaring.

* * *

DENMARK'S decentralized gliding contest, Per Weishaupt writes, included an individual class for the first time in 1960. The winner was Niels Sejstrup, whose three longest flights added up to 719 km. (447 miles) and gained him 1,282 points, including bonus for goals and for a 300-km. triangle which lay wholly within Denmark. Ib Braes, coming second, earned 1,110 points for 758 km. Sejstrup finished fourth in the Standard Class at last year's World Championships.

Civilian sailplanes in Denmark now number 89. The Schleicher types are popular, and five of the East German Lehrmeister, a two-seater trainer, have been ordered.

* * *

EIGHT entries in League 1 at this year's National Championships are planned by the R.A.F. Gliding and Soaring Association, and an unspecified number of "reserves" in League 2.

This year the Association is starting a "league" for inter-station competition. The trophy is the "Bicester Cup," presented by Sqn. Ldr. G. H. Daniels. Last year's totals, to which 15 clubs contributed, were 6,732 hours from 48,111 launches, and 15,013 miles across country. Total membership rose by 550 to 2,222.

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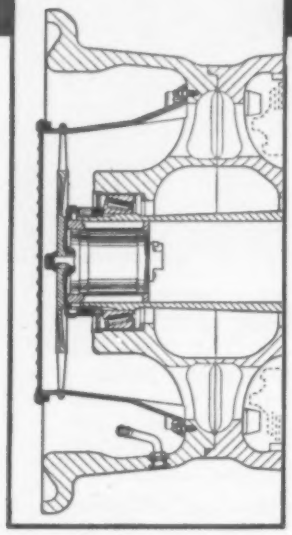

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Correspondence

An Imperial First

I AM prompted to write on account of an article on page 849 of your issue for Dec. 30 last headed "The Value of Flight Recorders."

This article purports that the recorders in the DC-8 were a pioneering effort and entirely new. May I remind you that in 1922 Daimler Airways installed, in the D.H.34, recording tachometers made specially by a Swiss company for Daimler Airways. The name of the manufacturer escapes me at the moment.

The charts from those recorders were stuck in guard books and were the time records for all flights, as they checked take-offs and landings, as well as r.p.m. during flights. These were the official company records of all flights for many years.

It is true, of course, that these instruments did not record air-speed or altimetry, etc., but they were without doubt the first attempt at mechanical recording during flight, and were highly successful in that.

Westport, Conn., U.S.A. G. E. WOODS-HUMPHERY.

High Viscount Utilizations

IN the course of your article on M.E.A.'s Comets in the Jan. 13 issue of THE AEROPLANE AND ASTRONAUTICS, reference is made to the high average utilization recorded for that company's Viscount aircraft.

The utilization figure for Aer Lingus—Irish International Airlines' Viscounts during August last year may be of interest in this connection. Our average daily figure was 9 hours 41 minutes (or 3,534 hours per year).

Ath Cliath (Dublin), Ireland. BART B. CRONIN
(Press Officer, Aer Lingus).

Swing-tail Freighters

I AM afraid I must challenge the editorial comments following the recent letter (Jan. 27 last) of Air Cdre. Kirk concerning the uniqueness of the swing-tail Canadair CL-44D. Surely the Breguet 490H of circa 1949 was intended for freight-loading;

it certainly flew at the Antwerp display of June, 1950, where I procured the accompanying photograph.

Orpington, Kent. D. I. PUNNETT.

[An early proposal to hinge the rear fuselage to facilitate loading was that made by the late H. P. Folland, who designed a cargo transport with this feature in 1922 while he was chief designer of the Gloucestershire Aircraft Co. It was not built. Interest in the idea revived after World War II, one of the earliest projects being the 100,000-lb. Curtiss Wright CW32 of 1947, in which the tail was hinged upwards.—ED.]

Fast Landing, Slow Burning

WITH reference to the take-off crash of the DC-8 of Aeronaves de Mexico at Idlewild on Jan. 18 (THE AEROPLANE AND ASTRONAUTICS, Jan. 27 last), the known facts are that with 106 persons on board, the DC-8 took off for Mexico City in a driving snowstorm, high wind and poor visibility, described by news reports as a near-blizzard. F.A.A. officials say that the take-off conditions of a quarter-mile visibility and an obscured 300-ft. ceiling were within minimum requirements.

According to accounts of survivors, the aircraft left the runway in a normal take-off, rose only about 20 ft. or so, and then came down hard, crashed through the airport fence, struck a car on the highway and mowed down an electric light pole. The nose ploughed a crater in a marsh and the front part of the aircraft broke away. Survivors clambered through broken windows, emergency doors and the open ends of the fuselage just before the aircraft burst into flames. By a near miracle only four crew members, all Mexicans, died in the front part of the wreckage, while only seven passengers out of a total of 98 were injured seriously enough to be hospitalized.

Two facts seem clear enough:—

1.—The proponents of kerosene for safety, with Lord Brabazon as their top test match player, have been vindicated once more. If we must have fast landings (and long take-offs) because of exaggerated wing loadings and inadequate lift-thrust exploitation of the wing, then the adoption of kerosene for slow burning after a ground crash appears mandatory, since it does provide those few precious seconds for escape from the funeral pyre.

2.—The proponents of underwing podded jet engines, led by Boeing, have been unable to substantiate their earlier claim that

Groundabout

From the BEA Magazine: "A typed record of the B.B.C. 'Radio Newsreel,' made by our P.R. Branch, read 'Safety in the air was also in the news due to the temporary grounding of the Vicar's Vanguard aircraft.' Evidently a clerical error."

*

"—and so we decided to return to basic principles. . . ."

A Tattle of Titles. In the *Royal Aero Club Gazette*, editor John Blake ponders on the noun of assembly for missiles—"A leash of Bloodhounds? A ford* of Thunderbirds?" A flash of Firestreaks? A slime of Seaslugs? Some assemblies are already called squadrons, of course, and I suppose the others will end up mundanely as batteries.

*The car, you know.

*

This is Ridiculous. I've heard of paperwork coming thick and fast, but how about "an aerobatic C. of A. with 200 m.p.h. cruise" in one of our recent Aircraft for Sale ads.?

*

Check. May I quote Captain Lincoln Lee's nice simile in the latest issue of the Journal of the Guild of Air Traffic Control Officers?: "A Pilot . . . may not know that perhaps the Controller, with a large number of aircraft on his screen, has no stand-by set available if that breaks down. In my opinion this is rather like playing three-dimensional chess on a one-legged table."

*

Per Ardua Ab Initio

"What we're supposed to be doing is spelt 'd-u-*A*-l'."

*

Line Shot I

At Briefing: The Met. man puts his chart on the epidiascope upside down.

Voice from the back: "Ah, obviously an inversion."

*

Line Shot II

A hundred miles south-east of Malta, two Valiants passed each other at about 40,000, "H" flying to El Adem, "K" flying *from* El Adem.

"H" pilot: "Morning, Ken."

"K" pilot: "Morning, Harvey."

"H": "What's the weather like for bombing at El Adem?"

"K": "I don't think you'll have much luck. About six eighths."

—and more of the same. After they'd finished, a navigator commented: "There. A couple of chaps meet two thousand miles from home and all they can talk is shop."

by Gordon

Correspondence . . . .

the fiery barrels were so designed as to break off from the wing structure on impact with the ground and roll clear. In actual practice, in numerous instances, it has not turned out that way at all. Slowly, but surely, the evidence is building up that this particular wing-engine configuration is the most dangerous way to mount a propulsion system to the airframe.

In the meantime, if we must settle for fast landings and extended take-offs, we might as well insist on slower-burning bonfires by the use of kerosene for turbine fuel. The other problem of jet-engine installation is really no problem at all, for it was solved in the World's first civil jet airliner, the D.H. Comet 1. A more extended wing-root of low thickness/chord ratio still offers the best all-round location for jet engines because such a layout can also be exploited for jet-flap lift and slower landing.

Santa Monica, Cal., U.S.A. STANLEY H. EVANS.

DC-8 Chronology

HAVING read with great interest your fine report "Douglas Commercial Eight" (Nov. 25, 1960, issue), may I add a few friendly comments?

Most of the latest information you published under the heading of "Flight and Performance Development" was disclosed, publicly for the first time, by Mr. O. R. Dunn of Douglas in his lecture entitled "Flight Characteristics of the DC-8" at a Los Angeles gathering of the S.A.E. held in October last year. I'm very surprised to observe you have made no mention of this important fact!

A notable omission in your Chronology Chart is that Douglas delivered their one hundredth DC-8 on Oct. 10, 1960: this being a Series 30 aircraft for Pan-American. Your sectional drawing of the DC-8 by J. F. Wixey is one of the best I have seen but, a minor omission is that it should have been titled "Series 40 Intercontinental Model."

Finally, just to keep the records straight, there are (currently) a total of 23 R.-R. Conway-powered DC-8s ordered of which only a few still remain to be delivered to T.C.A., C.P.A. and Alitalia. This compares with a total of 28 Conway-powered 707s, of which only three remain to be delivered (to Air India and El-Al).

Nairobi, Kenya. DENNIS M. POWELL.

Books and Publications Received

Flying Saucers and the U.S. Air Force, by Lt.-Col. Laurence J. Tacker, U.S.A.F. In this overdue volume, the author reviews fully and dispassionately the story of "Project Bluebook," the U.S.A.F.'s continuing study of unidentified flying object sightings since June, 1947. Methods of analysis, possible explanations, constructive and abusive letters from the public and hoaxes are all described, and a valuable appendix reprints Department of Defense News Releases from 1955 to July, 1960, setting out the conclusions reached in analysing 6,523 reports. The illustrations show how various natural phenomena and aircraft can be mistaken for UFOs. 164 pp., 6½ in. by 10 in. D. Van Nostrand Co., Ltd. Price 26s. 6d.

Aeroplanes, by John W. R. Taylor. A new title in the series of "How Things Developed, Information Books" in which basic knowledge about aircraft and flying is imparted in easy-to-understand text and a large type face. 90 pp., 6¼ in. by 8¼ in. Illustrated. The Educational Supply Association, Ltd. Price 9s. 6d. (7s. net in semi-limp edition).

The Modern Airliner, by Peter W. Brooks. This volume is not a technical description of modern transport aircraft, as the title might suggest, but a study of the evolution of the airliners of 1960, starting with the types used in 1919 for the first commercial services. All aspects of development—structure, economy, performance, and other factors—are authoritatively discussed. A companion volume in preparation will give detailed information about the airliners now in service. 176 pp., 5¼ in. by 8½ in. Illustrated. Putnam and Co., Ltd. Price 30s.

INDUSTRY RECORD

Comet Starters

Ground power units for starting and servicing duties for Comet 4Cs have been ordered from Auto Diesels, Ltd., by Middle East Airlines. Each unit will be a standard G.P.U.3 mounted in a Rootes Gamecock chassis having a Leyland type 680 six-cylinder diesel engine and Crompton-Parkinson generators. Delivery of the first units has begun.

Repairs and Overhaul

Contracts worth some £42,000 have been received by Normalair, Ltd., of Yeovil, for the overhaul and repair of 140 cooling turbines and 220 liquid oxygen converters for F-84F Thunderstreaks of the Federal German and Belgian Air Forces. The first units are already going through the company's workshops. Some of the units were originally manufactured by Normalair for Republic Aviation under United States offshore procurement contracts.

SARAH in South America

Ultra Electronics, Ltd., is to export SARAH search and rescue homing equipment to the Argentine. Three airborne transmitter/receivers for installation in Beavers and a quantity of personal beacons are to be supplied. This new order brings the total of countries using SARAH up to 25.

SARAH beacons, along with engine electric control systems and communications control equipment, will be exhibited by Ultra at the British Trade Fair to be held in Moscow from May 19 to Jne. 4.

Weather Radar

Ekco airborne weather radar equipment has been fitted in the first Middle East Airlines Comet 4C which entered service on Jan. 5. A further three M.E.A. Comet 4Cs scheduled to be operating by April, will be similarly equipped.

The Ministry of Aviation has also awarded contracts to Ekco Electronics for the supply of weather radar installations for A.W.600 military transports.

Aviation Calendar

Feb. 10

London.—R.Ae.S. Man Powered Flight Group lecture, "Insect Flight," by Dr. J. W. S. Pringle, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

Feb. 11

Birmingham.—British Interplanetary Society, Midlands Branch lecture, "Fusion Rockets," by C. L. Johnson, in the Birmingham and Midland Institute cinema, Paradise Street, at 18.30 hrs.

Feb. 13

Coventry.—Lanchester College of Technology, Rocket Engine Technology lecture, "Liquid Propellents," by A. W. T. Mottram, in the College, at 19.00 hrs.

London.—Institute of Transport Brancker Memorial lecture, "Aviation—the Next Stage," by Air Chief Marshal the Hon. Sir Ralph Cochrane, in Jarvis Hall, 66 Portland Place, W.1, at 17.45 hrs.

Feb. 14

Glasgow.—R.Ae.S. Glasgow Branch Graduates and Students Section, visit to the Engineering Laboratories, Glasgow University, at 19.30 hrs.

London.—R.Ae.S. Cierva Memorial Lecture, "The Era of the Autogiro," by Prof. J. A. J. Bennett, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

Luton Airport.—R.Ae.S. Luton Branch lecture, "Mathematical Oddities," by R. A. Fairthorne, in the Napier Senior Staff Canteen, at 18.00 hrs.

Feb. 15

London.—Kronfeld Club lecture, "Special Air Service Operations in the Oman," by Col. A. Deane Drummond, in the Basement, 74 Eccleston Square, S.W.1.

Weybridge.—R.Ae.S. Branch R. K. Pierson Memorial lecture, "Some Aspects of Science in Support of the R.A.F.," by M. B. Morgan, in the Apprentice Training School, Vickers-Armstrongs (Aircraft), Ltd., at 18.00 hrs.

Company Notices

NEW COMPANIES

LLOYD INTERNATIONAL AIRWAYS, LTD. (681,075).—Private co. Reg. Jan. 19. Cap. £100,000 in £1 shs. To establish, maintain, work and carry on lines of aerial communications by means of aeroplanes, seaplanes, flying-boats, helicopters, hovercraft and other aerial conveyances. Directors: Charles B. M. Lloyd and Alastair L. Macleod. Sols.: Stitt and Co., 4 Paper Bldgs., Temple, E.C.4. Reg. off.: 28 Conduit St., W.1.

WILLATE, LTD. (680,579).—Private co. Reg. Jan. 13. Cap. £100 in £1 shs. Automobile, marine and aircraft engineers. Sec.: L. R. Battell.

NORCOL, LTD. (680,770).—Private co. Reg. Jan. 16. Cap. £100 in £1 shs. Other particulars are similar to Willate, Ltd.

INCREASES OF CAPITAL

Bristol Aircraft, Ltd. (652,819). Stonebridge House, Colston Avenue, Bristol, 1.—Increased on Jne. 9, 1960, by £2,499,900 in £1 ordinary shs., beyond the reg. cap. of £100.

British Aircraft Corporation, Ltd. (650,233), Vickers House, Broadway, S.W.1.—Increased on Jne. 15, 1960, by £19,999,900 in 7,999,900 "A" ordinary, 8,000,000 "B" ordinary and 4,000,000 "C" ordinary shs. of £1 each, beyond the reg. capital of £100.

New Patents

APPLICATIONS ACCEPTED

863,685.—**Costruzioni Aeronautiche Giovanni Agusta.**—"Helicopters."—May 13, 1959. (Mar. 27, 1959.)

863,686.—**Costruzioni Aeronautiche Giovanni Agusta.**—"Helicopters."—May 13, 1959. (Mar. 27, 1959.)

Printed specifications of the above will be available on Mar. 22, 1961, and the opposition period will expire on Jne. 22, 1961.

Personal Notices

BIRTHS

Bassett.—On Jan. 26, at the Jersey Maternity Hospital, to Rosemary (*née* Hall), wife of Flg. Off. R. Bassett—a daughter.

Broadhurst.—On Jan. 23, at P.M.R.A.F. Hospital, Halton, to Frances (*née* Clayton), wife of Flt. Lt. B. Broadhurst—a daughter.

Lloyd.—On Jan. 18, at Zachary Merton Maternity Hospital, Rustington, to Mary (*née* Dye), wife of Flt. Lt. D. Lloyd—a son.

Smith.—On Jan. 23, at R.A.F. Hospital, Nocton Hall, to Janet (*née* Duke), wife of Flt. Lt. R. Smith—a daughter.

White.—On Jan 22, to Esme, wife of Flt. Lt. G. A. White—a daughter.

DEATH

Pearce.—On Jan. 28, Wg. Cdr. Harold Pearce, R.C.A.F., at St. Thomas's Hospital, Hydestile, Milford, Surrey, aged 54.

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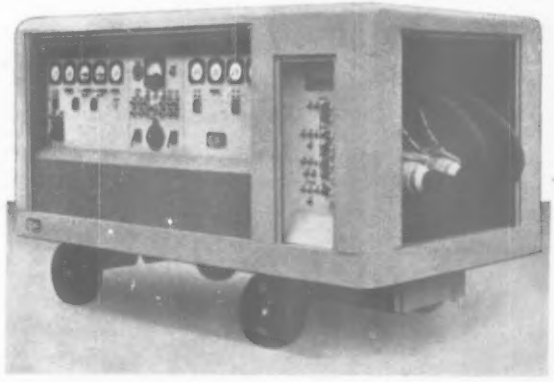

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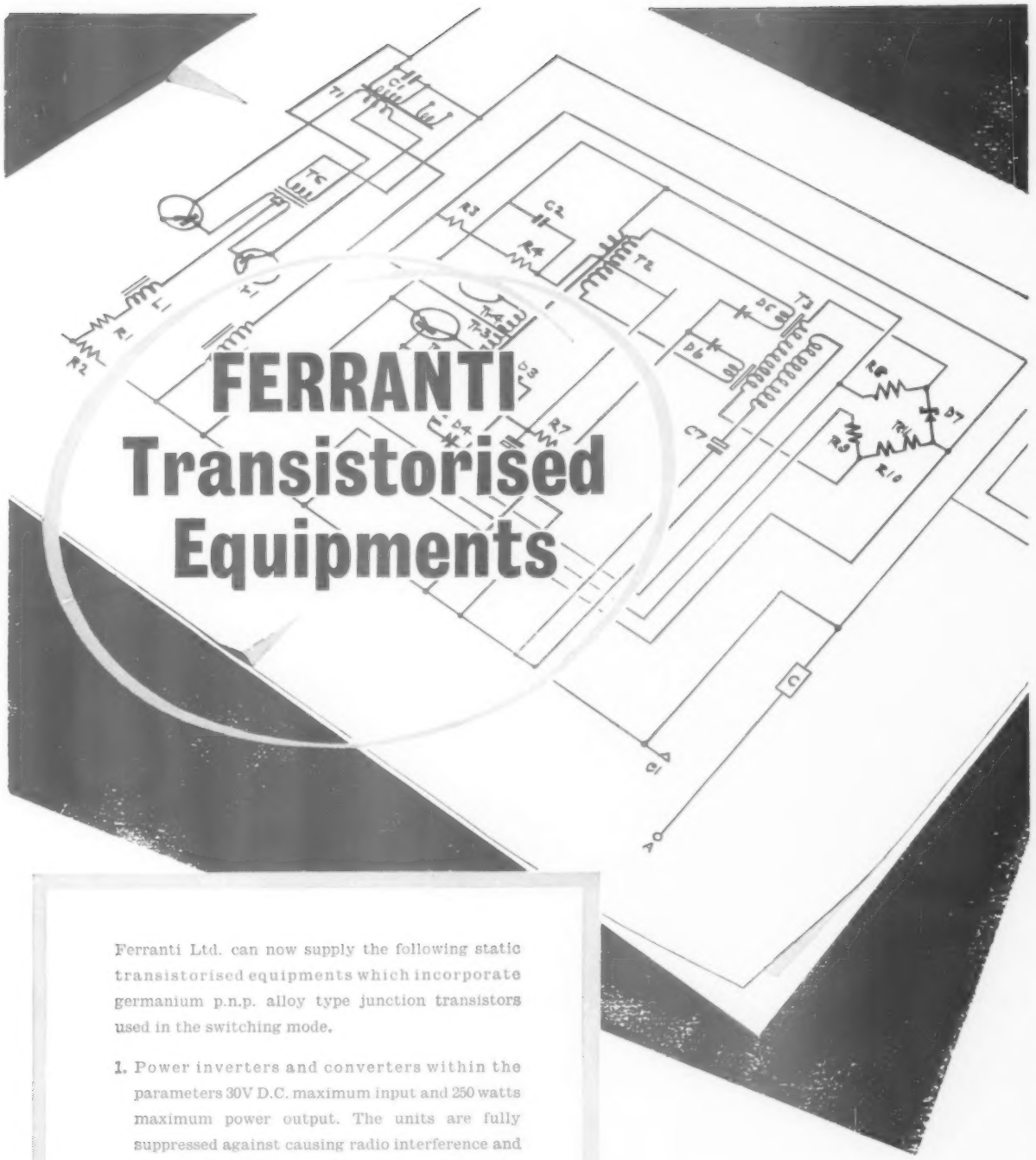

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Long haul into Patagonia

To the armchair traveller, Patagonia is a remote, almost legendary land that spells adventure. But to the truck-driver hauling aviation fuel to Rio Gallegos airport, near the extreme tip of Argentina, the adventure is stern reality.

From Bahia Blanca, the nearest supply point 1,380 miles away, the journey is arduous and often dangerous. Over mile after mile of rough desolate roads, strewn with boulders and stones, the drivers dare not relax. Round the corner may be a steep embankment. There are frequent gales, sometimes up to 110 miles an hour; temperatures can fall to 4° below zero and torrential rains may turn the primitive roads into quagmires. Under these conditions, regular delivery of aviation fuel becomes quite a task.

Nevertheless, at the Rio Gallegos airport, future gateway to Antarctica, fuel supplies never run dry. Shell sees to that. The red and yellow tank trucks which transport 5,500 gallons each trip are now a familiar sight in these bleak lands. Even the timid "guanacos" no longer flee in terror before them. Sometimes, when a truck breaks down or is blocked by snow, aircraft of Aerolineas Argentinas and Austral covering that route act as spotters to rush help through.

1,380 miles is a long, long trek. It becomes even longer when, in an emergency, the fuel has to be sent direct from Buenos Aires — another 430 miles! But, always, the job is done. Wherever aviation fuel is needed, Shell will see it gets there.

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